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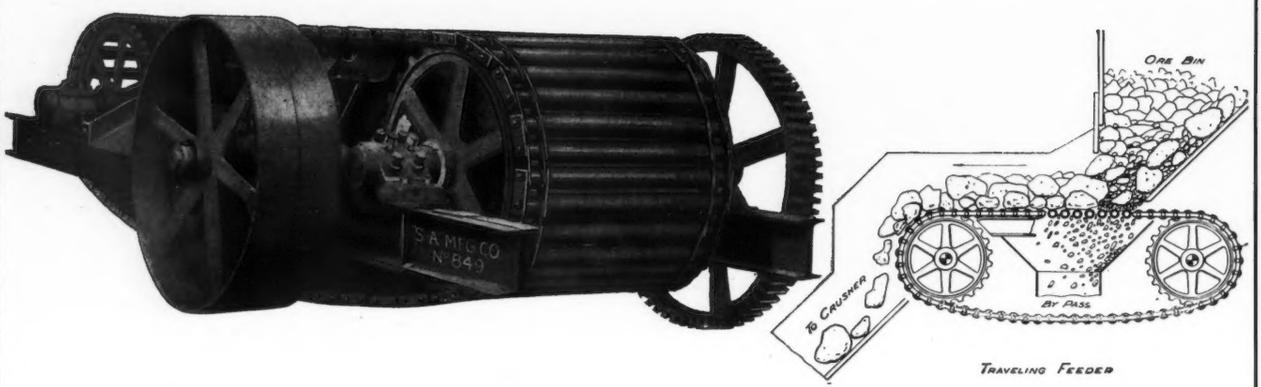

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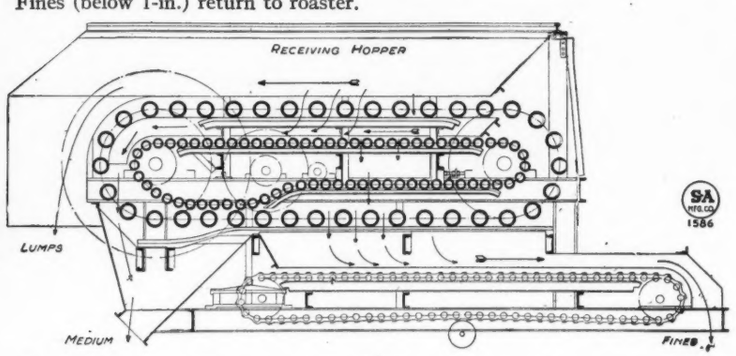
3-in. to 24-in. lumps to crusher.
1-in. to 3-in. lumps by-pass crusher. } To Furnace.
Fines (below 1-in.) return to roaster.



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Engineering and Mining Journal

VOLUME 102 OCTOBER 14, 1916 NUMBER 16

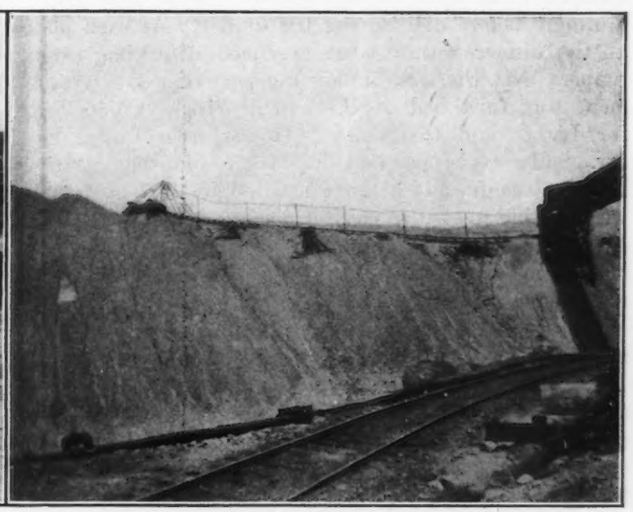
Institute Meeting in Arizona

By P. E. Barbour and R. D. Hall

SYNOPSIS—Details of visit of the American Institute of Mining Engineers to the big mines and reduction works of Arizona, the Roosevelt Dam and the Grand Cañon. A special train of 14 cars, including two private cars of copper magnates, were required for the party. Incidents of the most successful trip of the Institute with the members at work and at play.

The 113th meeting of the American Institute of Mining Engineers came to a fitting end at the Grand Cañon, Arizona, Sept. 25. The visit of the Institute to Arizona was the most successful of a long list of successes of this kind, and after visiting so many wonderful mines, milling and smelting plants, and after having had such a strenuous good time, the Grand Cañon alone could be a climax.

HILLSIDE, AT MIAMI, SHOWING "BLOCK FAULTING" DUE TO UNDERGROUND CAVING



PIVOTED CONVEYOR FOR WASTE AT OLD DOMINION SHAFT NEAR GLOBE, ARIZ.

A comparatively small party started from New York Sept. 14, but had increased sufficiently on reaching Chicago to be given an interesting drive through Washington and Jackson Parks and a banquet at La Salle Hotel. The private car "Anaconda," of B. B. Thayer, was attached to the A.I.M.E. special here and proceeded to El Paso, where the party was augmented by the addition of various Texas, Colorado and Arizona members, including the Arizona committee.

Sunday, the day of arrival, was spent visiting the city, its National Guard camps, Fort Bliss, the busy streets full of soldiers and the El Paso smeltery. This plant, originally a lead-smelting installation, has been transformed, owing to cessation of lead shipments from Mexico and the increase of copper shipments from Arizona, into a smelting plant in which copper is the leading product. One of the most interesting features of the remodeled and enlarged plant was the new and largest Peirce-Smith converter, 13 ft. diameter, which is taking three times as much air as its 11-ft. predecessor and is expected to establish a new record for copper converted.

Karl Eilers and P. A. Mosman, who had been in the West more than a month making a regular tour of the American Smelting and Refining Co.'s plants, conducted the party through the El Paso plant and continued with them to Arizona.

On Sunday evening a most interesting banquet was served at the Toltec Club, about 175 being present. The menu consisted wholly of Mexican dishes the nature of which could not be always anticipated by those visiting guests who were not familiar with Mexican cooking. On each menu card was pinned a small Mexican sombrero, about 1½ in. diameter, which every guest promptly pinned on his or her coat lapel. A Mexican band dispensed music in true Mexican style throughout the evening and gave the Mexican atmosphere and helped to make the evening enjoyable.

After this banquet the party motored to its train and encountered the first of a series of carefully planned

and most successfully executed arrangements by the Arizona committee. In a way big things would be expected of those prematurely gray young men who are guiding the destinies of the big Arizona properties, but even so, the most frequent comments regarding the trip related to the ever surprising perfection of the committee's arrangements. Elaborately illustrated booklets containing the program of the trip, many illustrations and data of Arizona mines and reduction works were distributed as the train started.

Entertainment and Instruction at Santa Rita

Early in the morning the party arrived at Santa Rita, N. M., to be awakened fittingly by the sound of blasts in the Chino opencuts. After breakfast bunting-decorated flat cars provided with seats took the party to the steam-shovel pits of the Chino Copper Co. On their return the guests were offered a choice of trips—a descent into the openpits, a visit to the iron mine at Fierro, an inspection of the new crushing plant on the road to Hurley, or a trip to the Empire Zinc Co.'s mine, mill and magnetic separator at Hanover.

Hordes of automobiles ("hordes" is the word) were at the service of members at every turn, and the most strenuous trip of the Institute was in full swing. At noon all returned to Santa Rita, where genial John Sully, the general manager, gave a barbecue on the concrete tennis courts, over which had been stretched a huge canvas tent. The excellent band of the Eleventh U. S. Cavalry, from Fort Bayard near-by, played most entertainingly before and during the dinner. At each plate at the dinner was a large specimen of Chino native copper. Not the least interesting part of the entertainment was furnished at the extemporized "Chino Bar, for Ladies and Gentlemen." It was a real bar, too. Mr. Sully explained that he had to do that because Arizona was dry and he knew a lot of his Arizona friends were coming to visit him. Somebody had stolen a safety-first sign from the automobile roadway and hung it behind the bar, reading "Slow up," which admonition proved reasonably efficacious.

Outside the Chino office were many interesting specimens of ore and old relics of Spanish mining—the Santa Rita mines having been worked almost two centuries ago. There were old bullhide bags and rawhide ropes, chicken ladders and sets of mining timber framed in typical old Mexican style, with the caps resting on posts between two horns projecting from the posts. There were sheets of native copper, some of them 4 or 5 ft. across, and one chunk of chalcocite, recently found, weighing 1,300 lb.

When the time for leaving Santa Rita arrived, if Mr. Sully's Arizona friends expressed any regrets about leaving, they were again at ease when the automobiles landed the party at the Chino mill at Hurley, 10 mi. away, and "Sully's Second Free Thirst Quencher" was met.

The Chino mill was open to all visitors, and the interesting flotation work was explained and investigated with great interest. Souvenir bottles were given containing three layers of different colors—the black sulphide concentrates on the bottom, the green carbonate flotation concentrates next, and the red copper on top, which had been precipitated on iron, then "rumbled" off and floated.

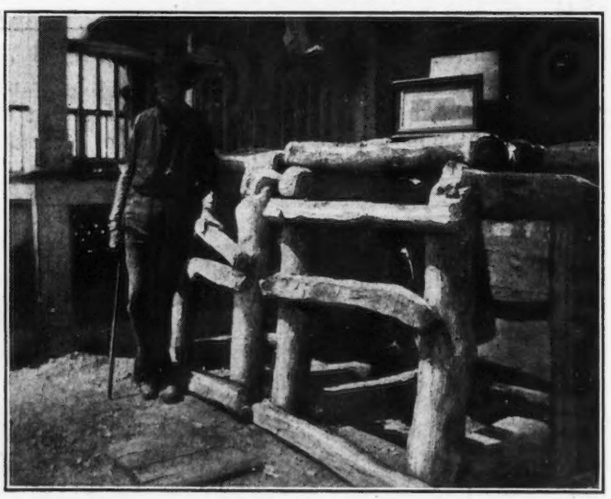
The visitors were much interested in the Chino type of concentrate car, also in the new type of cooling towers that are being added at the power plant to replace the old-style wooden towers now used.

After visiting the mill, the party was carried in automobiles to the series of tailings dams, which are so constructed that all the water is conserved and the tailings also. The latter are to be treated in a flotation plant now in the process of construction at that point.

After dinner in the dining car, an open-air dance was given on an elevated pavilion erected and lighted for the occasion, the Eleventh U. S. Cavalry band again providing most acceptable music. When the train pulled out that night, a tired but happy party conceded it to have been "some day."

The Meetings and Visits at Douglas

Tuesday morning the A.I.M.E. special, of 14 cars, reached Douglas, where the Sixth U. S. Artillery band was playing martial music and automobiles were waiting to take the party to the Copper Queen smeltery. On entering the plant the dusty crowd was tempted by the spray cooling system, which looked like an inverted



TIMBERING FROM OLD SPANISH WORKINGS NEAR SANTA RITA, N. M.

shower bath. This method of cooling power-plant water is becoming particularly popular in the Southwest. It is used also at the Inspiration and Miami plants. An addition is being built to the roaster building to accommodate four more units, which will make the number 20 in all.

Special interest was shown in the casting machines and the million-dollar pile of blister copper stacked up outside because the refinery in the East could not handle it. The oil-fired reverberatories also attracted attention. Pamphlets were distributed showing the flow sheet of the plant and data of equipment and operating details.

The A.I.M.E. train had been switched into the yard and took the party over to the Calumet & Arizona plant. The ore-bedding system and the reclaiming machine attracted much interest and aroused some discussion as to the loss by dusting during dropping the ore from the conveyors to the beds. This loss is admitted, but it is ore and is not considered serious. With the rich concentrates at Inspiration, however, specially designed cars were made to prevent any such loss in handling

the products, and bedding and mixing are done in a covered building.

The new sulphuric-acid plant held interest for a considerable time. Much of the interior steel work was in place and one lead-lined chamber was almost completed. The Great Falls type of basic converter is used at this plant and also at the Copper Queen.

At noon a buffet lunch and hot coffee were served at tables under the blast-furnace dust chamber, which is a sufficient commentary on the cleanliness of the plant and its freedom from dust. The military band supplied popular music and when the A.I.M.E. train was taken back to Douglas and backed down to the Y.M.C.A. for the technical session, the band went along on its special car—a flat fitted up with seats and railings.

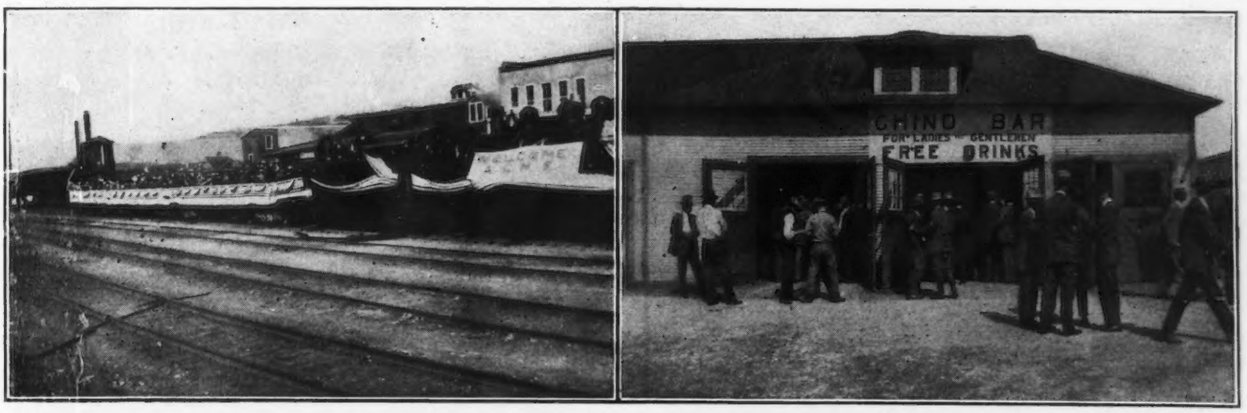
Artistic booklets of the smeltery were distributed showing various sections of the plant, plan and elevation of the sulphuric-acid plant, flow sheets and complete operating and equipment data.

Two technical sessions were held, afternoon and evening, and the usual welcoming speeches, etc., made.

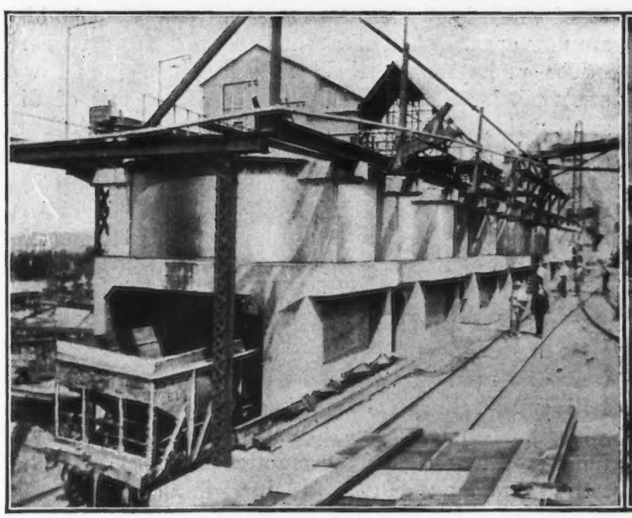
The Douglas meeting was opened by Dr. L. D. Ricketts, and Walter Douglas presided. J. C. Greenway, of the Calumet & Arizona Co., Warren, Ariz., made the address of welcome, saying, "Whatever of hospitality there is at hand, we offer you without measure." L. D. Ricketts responded, saying that he was both guest and host and therefore could not make an adequate reply. He called upon B. B. Thayer, who said that between six and eight of the happiest years of his life were spent in Arizona. Dr. James Douglas, he said, had done more for the Southwest than ever he had. The services of Dr. Douglas had been fittingly recognized in the naming of the town in which they were meeting. As in none of the smelteries of the region would you fail to find some of the handiwork of Dr. Ricketts, he proposed that some such thriving town as Douglas provide for the perpetuation of his name.

The paper of A. G. McGregor, on "Features of New Copper-Smelting Plants in Arizona," elicited the comment of Dr. Ricketts that the three lines of improvement in smelting had been cheaper cost in handling, larger units and decreased loss of copper. He felt that the chief loss is possibly in the discharge from calcine cars. Later the discussion reverted to the losses in unloading from railroad cars. S. J. Jennings, of the United States Smelting, Refining and Mining Co., declared the dry and high winds of Arizona might well carry off large quantities of dust. He pointed out that the volcanic dust resulting from the explosion of Krakatoa traveled twice around the world.

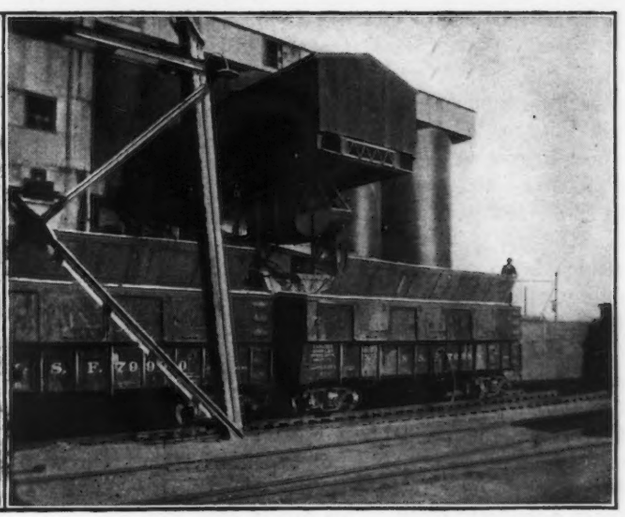
A. G. McGregor said that the need for the protection of the dumped material depended on its percentage of copper. Precautions were justified at the Miami plant because the material handled was of such high grade.



THE A. I. M. E. PARTY EN ROUTE TO INSPECT THE CHINO COPPER PROPERTY



CONCRETE CONCENTRATE BINS AT THE OLD DOMINION WORKS



CONCENTRATE CARS OF THE CHINO COPPER CO. AT HURLEY, N. M.

Dr. Ricketts condemned the dropping of material in the open and the practice of leaving bins uncovered. He showed that though in the past many losses were allowed to occur without explanation, we were now approaching a time when we would not permit any of these losses to occur. The Cottrell system is most successful in reducing the loss in dust. There is still a small loss when turning the converters up or down. In drying there are no losses, and the dust losses from the reverberatories are negligible and do not justify the installation of any collection system. In fact the reverberatory losses are about 0.18%. Of all losses, as he said before, none equal those from the discharge of the calcine cars.

Results with Basic-Lined Converters

F. N. Flynn's paper on "Smelting at the Arizona Copper Co.'s Works" aroused much discussion. L. O. Howard declared than the gross output of one converter at the Old Dominion smeltery at Globe—70 million pounds of copper—was only attained owing to the excellent grade of the matte and to the great care taken of the lining.

E. P. Mathewson, of the Anaconda Copper Mining Co., Anaconda, Mont., said that when converters of the Great Falls type are tilted, the tuyeres are not all equally covered and splashing results. But the silica is more readily distributed than in the Peirce-Smith type. The linings in the Northwest last almost indefinitely, but for the best results the silica must be kept low in the furnace and the ore should be magnetic in character.

Later the discussion turned to the dust losses, and Mr. Mathewson declared that "metallurgy is the art of making money from ore," and so good practice would never permit us to save anything out of which no profit could be made. By using large dust chambers the gas could be caused to travel at reduced speed and it could also be cooled sufficiently. But there was no advantage in excessive cooling such as might be obtained by drenching the gas with water, for if the sulphur dioxide is rendered too cool, it just rises to the top of the stack and rolls down on the surrounding territory, whereas if the temperature is high enough, the gas will rise and diffuse over a larger area, the physicists to the contrary notwithstanding. There is no market in the Northwest or the Southwest for much of the dust that goes out with the smoke.

Dr. James Douglas telegraphed his congratulations to the institute, and the meeting instructed Dr. Ricketts to make a suitable reply to his kindly greetings.

The Arizona drought was encountered here, but the Y.M.C.A. had large bowls of enticing looking but perfectly harmless punch labeled, "Arizonhauser," which was sufficient unto the need.

The ladies of the party were entertained at tea at the Country Club, and a general gathering there in the evening followed the technical session. B. B. Thayer held an informal reception of many members of the Montana National Guard stationed at Douglas.

The run to Bisbee was made during the night, and after breakfast another horde of automobiles, all duly tagged and numbered, were at hand for the various trips arranged. It is a standing joke in all the places visited thus far that almost every new auto means United Verde Extension money, and this was true also at Globe and Miami.

Four different trips were arranged for this day, it being possible for each party to make only one. The underground inspection of the Calumet & Arizona Mining Co. included a change of clothing at the Junction shaft and entrance through the concreted 5-compartment shaft to the 1,100-, 1,200- and 1,400-ft. levels and thence to the Briggs mine and the 30 and 93 stopes in the Tintown vein, at the southeastern end of the developed area, where rich oxidized ore occurs in a well-defined steep vein. Mining is by the square-set method and by underhand stoping with stringers.

In the 96 stope, in the large Briggs sulphide orebody east of the shaft, the ore is solid pyrite with chalcopyrite and a little bornite in irregular replacement bodies. A modified Mitchell slicing system is used.

In the Junction mine, 1,500 level, stope 88 is a very large pyrite, chalcopyrite and bornite body, which is mined by the Gilman cut-and-fill system. Both mining and filling operations were shown to the visitors. They also visited stope 48, which is located in a body of siliceous breccia cemented by pyrite and chalcopyrite and is mined by the cut-and-fill system. This is the largest cut-and-fill stope yet opened up.

Some of the visitors entered by the Briggs and returned by the Junction shaft. On reaching the surface everybody had a shower in the men's changehouse. New underground clothes, new sou'westers and new bath towels were provided—the Arizona committee had not overlooked anything for the comfort or interest of the party.

The Copper Queen mines have 150 mi. of workings, 75 of which have been driven recently and 50 of which are now open. Three different trips were arranged here.

The underground trip to the Neptune tunnel was arranged for those desiring to see the deposit of disseminated sulphides in the main porphyry stock of Sacramento Hill. The metamorphic limestone adjacent to the hill was visited and a body of enriched sulphides along the famous Dividend fault, which is being mined by top-slicing, was shown to those who made this trip.

Sacramento Division of Copper Queen

The underground trip to the Sacramento division was arranged for those desiring to see the following features: Orebodies in the main contact zone around Sacramento Hill and in limestone showing all stages of primary mineralization, enrichment, impoverishment and oxidation; good examples of the prevalent methods of square-setting and top-slicing in the district; and in addition, the main ore-hoisting shaft, recently concreted while in operation.

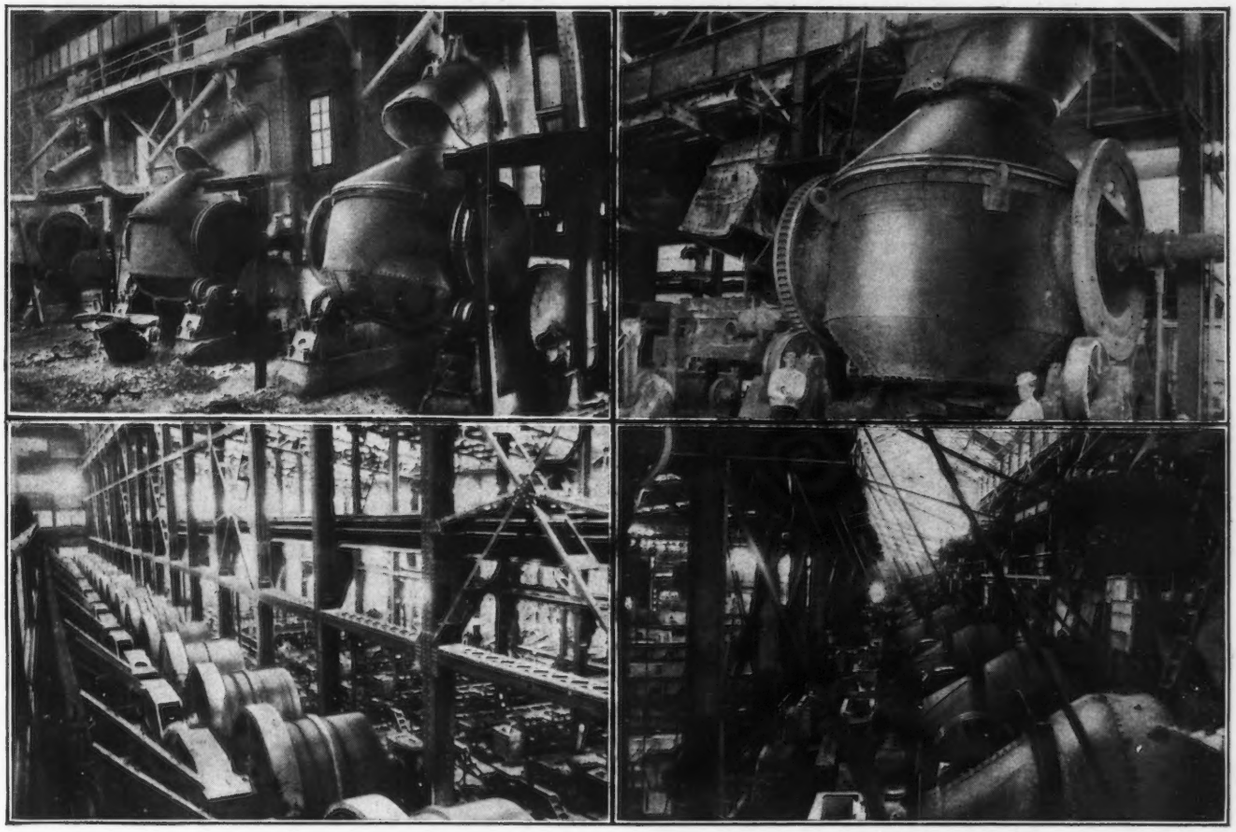
The surface and underground mechanical trip was principally for those interested in the mechanical equipment in use in the camp. The Sacramento main hoisting shaft of the Copper Queen, recently concreted while in operation, together with the surface ore-loading plant, and hoisting engines were visited first, followed by inspection of the central power house, the central tool-sharpening plant and the central sawmill of the Copper Queen, the Oliver power plant and the Junction power plant of the Calumet & Arizona, together with the great underground pumping stations of the Calumet & Arizona in the concrete Junction shaft, from which practically all the water in the district is pumped.

Ore from the Sacramento shaft is conveyed down an inclined belt conveyor to the ore-bedding system under

cover in the gulch below. Looking down on these long roofs, Kuno Doerr, manager of the El Paso smeltery, asked what they were and being informed it was the bedding plant exclaimed: "Ah! Here are some gentlemen in the mining business; they bed their ore before sending it to the smelter."

Many visited, during the afternoon, the Copper Queen experimental plant where, under the guiding hand of G. D. Van Arsdale, of Phelps, Dodge & Co., the sulphidizing and flotation of Morenci carbonate tailings were being tried out.

The technical session in the afternoon was held in a new and remarkable high-school building. The discussion



INTERIOR VIEWS AT SOME REDUCTION PLANTS VISITED IN ARIZONA

The upper views show Great Falls type converters at the Calumet & Arizona smeltery at Douglas and at the Old Dominion smeltery at Globe. The lower views show regrinding equipment—the left hand being the Marcy mill installation at Inspiration and the right hand the Hardinge mill installation at Miami

tended largely toward the sociological side of mining, and the meeting adjourned early in preparation for the evening's banquet.

It was brought out at the technical session that the Copper Queen mines 10 tons of ore for each foot of development work done. Mr. Goodale said that the Anaconda mined 9 tons of ore for each foot of development work. Later, at the Inspiration, the data given showed that with their system of mining and under their peculiar conditions 29 tons per foot of development was mined.

In the discussion on the "Geology of the Warren Mining District," contributed by Y. S. Bonillas, J. B. Tenney and Leon Feuchère, F. L. Ransome said that while the dikes at Ray and at Globe may be identical, it is not safe to assume their identity without at least more reconnoissance between those points. L. C. Graton said that it was generally understood that you could prove any theory at Bisbee, the geologic indications favoring the most divergent views. He added that in no other district had such careful microscopic work been done.

The article on "Coöperative Effort in Mining," by Joseph P. Hodgson, was discussed by J. A. Ede, of the Illinois Zinc Co., La Salle, Ill., and by C. W. Goodale, of the Anaconda Copper Mining Co., Butte, Mont. The latter said that success in the promotion of safety could not be attained if the whole reliance was placed on the vigilance of shift bosses, for it was impossible to provide so many of these officials that their work would be sufficient. It has therefore been the practice of the Anaconda company to lay men off for 7 days for working under unsafe ground. The period of suspension is made 14 days for the second offense and the man who is caught exposing himself to such risk for the third time is discharged. Thus the evil is corrected at its source. The smelting accidents are not so readily reduced as those around the mines; the hazards at the smelting plants were so many and various that the process of education was not so easy as in the mines.

Mr. Hodgson stated that it was useless to waste time attempting to teach men who were so set in their ways that they could no longer learn anything. It was better to put some young fellow under instruction for 7 to 14 days, in which time he would learn to handle the work and understand the system. D. W. Brunton stated that

the speed in driving headings had been increased from 250 to 750 ft. a month by carefully training the men who performed the work. Three shifts and three drills were used and the headings driven measured 7x8 ft. The increase was the natural outcome of careful training.

Banquet at the Warren Country Club

At Bisbee the Calumet & Arizona company distributed another well-printed, interesting and informative booklet illustrative and descriptive of the mines. A banquet was served at the Warren Country Club during the evening. The headquarters of this organization are beautifully situated at the mouth of the cañon overlooking the broad San Pedro valley. Just behind the clubhouse was the camp of the Twenty-Second U. S. Infantry and the District of Columbia militia. A battalion parade was given for the members before the dinner, which banquet needs favorable comment because it was wonderfully well done considering the number served and the difficulties encountered in catering in the desert.

The speech making was especially pleasing, which ordinarily is not the case. Philip N. Moore, vice-president of the A.I.M.E., made an excellent toastmaster and introduced the following toasts and speakers: "Welcome to Arizona," C. T. Knapp; "Arizona, Old and New," L. D. Ricketts; "Arizona Present," Walter Douglas; "The American Mining Congress," Carl Scholz; "Why We Are Here," Colonel Tillson, Twenty-Second U. S. Infantry; and "Ave et Vale," by John Mason Ross.

Dr. Ricketts' speech was largely an appreciation of Dr. James Douglas. Walter Douglas in introducing his toast expressed confidence in the ultimate outcome in Arizona when the period of somewhat rash experiment in government came to an end. He spoke in a somewhat different vein to the lawyers regarding the prohibition law, which he did not in any way regret, though it appeared at first sight an interference with personal liberty. Carl Scholz declared the American Mining Congress aimed to keep a line between the cranks and the crooks and to prevent the disturbing effect which the ill-considered plans of the first and the dishonesty of the second visited on the mining public in all parts of the country.

In introducing Colonel Tillson, Mr. Moore said that he had noticed that the middle names of all military men began with "D" and stood for "discreet," but nevertheless it might be that the colonel would tell why they were here. The colonel justified Mr. Moore's observation by saying it was a soldier's duty to go where he was sent and do what he was told; that he had been sent there and told to make a speech, and that therefore he was there to speak and the others to suffer. But the latter did not prove true, because he made the most-polished and pleasing speech of the evening. At the proper time the special train drew up near the club, the party broke up and the members entrained and started for Globe, Walte Douglas' private car "Nacozari" being attached here.

The party arrived at Globe about 10 a.m. Thursday, Sept. 21. Here also many automobiles were waiting to take the visitors to the Old Dominion reduction works. One of the most noticeable features of the surface equipment is the pivoted inclined belt conveyor for handling the waste rock from the mine. The feed end of the conveyer is pivoted, and the discharge end can be swung through a wide arc, thus making cheap disposal of the waste possible.

The Great Falls type basic converter which made 70,000,000 lb. of copper without relining attracted much attention, as did the flue-dust-and-gas measuring and testing arrangement at the base of the big stack. Owing to the increased amount of fine concentrates and the sulphur content, it is anticipated that this plant will at an early date be remodeled or replaced with roasting and reverberatory-smelting equipment.

In the afternoon, while the ladies were being entertained at the Cobre Valle Country Club, a technical session was held, followed by another in the evening.

Methods of Controlling Mine Fires

The papers on mining and stoping methods did not bring out much discussion, but it was around the paper on "Mine-Fire Methods Employed by the United Verde Copper Co.," by Robert E. Tally, that most of the discussion centered.

It was the opinion of those who had done most underground fire fighting that the only way to extinguish such a fire was to put water on it. To be able to do this, the Copper Queen devised a motor-driven blower mounted on a truck equipped with 1,500 ft. of wire and 500 ft. of 10-in. air pipe. This car has a regular station and can be quickly dispatched to any point from which a fire alarm is sounded. The air blown in beats back the smoke and in several cases this outfit has enabled the men to reach the actual fire and quench it with water.

C. W. Goodale read C. L. Berrien's discussion of the paper on mine fires, which emphasized the importance of using the main shafts as downcasts so that men could escape safely up these. It was admitted that this was an unfortunate arrangement in a cold climate, for when being hoisted, the men were met with the keen air of the surface while still covered with the perspiration engendered by the hot workings. He spoke of drilling holes from the surface to reach fires below. This, another speaker declared, might work well in Butte where the rock to be thus penetrated is hard, but would not do well in the United Verde where the rock is soft and could hardly be drilled. At the United Verde mine the material is so soft the air driven in under the plenum method can always find an adequate way out. At Butte, drilling and watering are, however, quite feasible according to this speaker. His opinion was that the heating at Bisbee was always from the chemical action of the pyrite and from the absence of ventilation. However, he could not be sure that the carelessness of the miners was not sometimes the cause. J. A. Ede regarded the matter from experience gained in coal mines, and he condemned the use of water in extinguishing mine fires.

Dr. Rudolf Gahl read his paper on the "History of the Flotation Process at Inspiration" and stated that since he had written it he had learned several matters that would cause the work at the mill to be somewhat changed, limestone precipitation being used for carbonates and silicates. He said that all the work could be done without tables, but it would involve the use of expensive oils. However, he added that table middlings would be given flotation treatment.

E. P. Mathewson said that though the impeller machines made a tougher froth than those of the pneumatic type, this was not necessarily a disadvantage, for while the froth may be harder to collect, the material

is less likely to fall back. He stated that he floated sands and slimes separately and did not feel that the two could be satisfactorily floated together.

It was this same speaker who read the paper by F. Laist and A. E. Wiggin on "Flotation Concentration at Anaconda, Mont." In the discussion O. C. Ralston wanted to know if the mixture used at the Anaconda plant was that found most desirable. In reply Mr. Mathewson said he was ready to be convinced that there were others more desirable. He said he omitted wood creosote when floating sands, but found it necessary for slimes. He stated that he had manufactured sludge acid, which he used as a flotation agent, from crude oil and he found it more expensive to make than to buy. It was, he said, just as good for flotation purposes.

It was stated that caustic soda at the Old Dominion cut insoluble residues down from 25% to 20% and a fraction. It saves water and increases the extraction.

SOME MEMBERS OF THE A. I. M. E. PARTY IN ARIZONA

1—E. W. Mills, superintendent, and J. F. Manning, mining engineer, of the Seoul Mining Co. of Chosen. 2—Mr. and Mrs. E. P. Mathewson, of Anaconda, Mont. 3—Norman Carmichael, manager of Arizona Copper Co., and B. B. Gottsberger, manager of Miami Copper Co. 4—Mrs. Bradley Stoughton, Secretary Stoughton and Sidney J. Jennings about to go underground at Sacramento shaft at Bisbee. 5—Charles E. Mills, manager of Inspiration Consolidated Copper Co. 6—John C. Greenway, manager of Calumet & Arizona Mining Co. and New Cornelia Copper Co. 7—H. A. Buehler, state geologist of Missouri, and Philip N. Moore, of St. Louis, one of the vice-presidents of the American Institute of Mining Engineers

Alkaline or neutral solutions are preferable in the Globe district, whereas acid solutions give the best results at most other places. Caustic soda is a marked help at the Old Dominion despite the fact that the pulp is already somewhat alkaline.

O. C. Ralston said that sodium resinate was being used at Chino, not so much for the purpose of a deflocculant as for the fact that it gave a good life to the froth. Thus made more permanent, it did not die and refuse to go over the discharge board.

He wanted to know how much oil should be used and if its quantity should be regulated by the amount of water to be used or the quantity of ore to be treated. Of course it was shown that the character of the oil had much to do with the quantity used. Everybody agreed that colloidal matter was harder to float satisfactorily than granular matter. Ralston declared that colloidal material appeared impossible of satisfactory treatment by flotation, but a distinction was urged between colloidal mineral and colloidal gangue.

The evening session ended with a paper read by Walter A. Schmidt on the results obtained by the Cottrell process of electrical precipitation at the International Smelting Co.'s plant at Inspiration, Ariz., and the Riverside Portland Cement Co. at Riverside, Calif. He illustrated his remarks with lantern slides and then, with an elaborate model of the system employed.

Interest in the Miami District

Friday was Inspiration day. A stub train with great limberness in navigating the sharp curves is run from Globe to the various plants in the Miami district. The Inspiration automatic ore-hoisting plant was actually awe-inspiring. Underground the landing stations, the car-dumping and loading stations were built in massive concrete and brought forth frequent comparisons with the New York subway. The rolling dump empties five 5-ton cars at a time. The ore goes from this bin to an automatic loader, which fills a skip-weighing pocket that is automatically tripped when the skip stops in its loading position and the ore is discharged into the skip. It is not again handled except by machinery until the final concentrates are made.

The Inspiration mill is a marvel—not only for what it is accomplishing, but for its design and appearance. It has been adequately described by H. Kenyon Burch, its designer, in his paper before the Institute at this meeting. From the mill the train seesawed down the jig-backs to the smeltery and then down to Miami, where another fleet of automobiles carried all up the hill to the Miami Copper Co.'s clubhouse, where lunch was served. The lunch was prepared in Los Angeles, for this part of the desert gave no facilities, and a caterer was imported with it.

After lunch the ladies had a bowling contest—adjourned later to enjoy a swim in the pool underneath the club room when the technical session began. This clubhouse is a veritable oasis in every way and afforded by far a more comfortable place for a technical session than any other hitherto provided. The paper on the results obtained from the Marathon mill brought out much discussion and contrary opinion, despite the conviction of F. C. Blickensderfer that the Marathon was producing startling results in fine grinding. C. W. Merrill was of the opinion that grinding with linear-contact would be far superior to that with spherical-contact and that a new grinding era might be about to be ushered in by the Marathon principle. Charles Legrand's paper on the Diesel-engine power plant at the Burro Mountain Copper Co. at Tyrone was of much interest, especially as the Miami, on the strength of the Tyrone results, is constructing an addition to its power plant to contain Diesel units. Extensive crushing experiments are being made at Miami, but B. B. Gottsberger said it would be months before conclusive results would be reached. The Miami mill was visited, of course, as well as the surface plants, and a few people went underground. Both the Inspiration and Miami distributed booklets containing photographs, flow sheets and copious data. A banquet at Globe that evening attended by nearly 300 concluded this part of the trip. The dinner was served in the auditorium of the high-school building.

The banquet was followed by speech making, Sidney J. Jennings presiding, fitly, as toastmaster. The toasts and speakers were: "Safety First," by John E. Bacon, a local surgeon; "The Growth of the Globe District," by Dr. L. D. Ricketts; "Why the Young Engineer Should Join the Institute," by E. P. Mathewson; and "The Utilization of Waste Products," by F. G. Cottrell. Mr. Cottrell said that the Bureau of Mines should keep on the scouting line a little ahead of the present, looking for new methods of treatment. He said that the gaseous output of a converter was from 20 to 25 times as great as the slag drawn off. We had looked in the past on recovery of metals as a problem of solids; we had learned later to attack them as liquids; perhaps in the future we shall seek to find our treatment problems in the gas.

The End of the Trip

Sunrise Saturday morning saw the whole party in automobiles bound over the Apache Trail to the Roosevelt dam and Phœnix.

Sunday morning the train, several hours late, arrived in Grand Cañon. Thanks to the delay it was decided to defer departure to the next day so that the stop here was longer than scheduled.

It was a happy thought to end the trip there. The Arizona committee had provided a most strenuous program. No opportunity was given for waits, and there were no dull spots. The party was whisked from one thing to another in the ubiquitous automobile until the limit was nearly reached. And the serene calm grandeur of the Cañon furnished a welcome rest to both mind and body. The monument to John Wesley Powell, on the brink of the Cañon at Maricopa Point, is a fitting commentary to the courage and daring of that fearless explorer, the father of our Geological Survey.

The party had been dwindling since leaving Globe, members going on various errands east, south and west, so that only three cars left the Cañon Monday night. Tuesday morning and also Tuesday noon found the pilgrims still waiting at Williams, Ariz., for the connecting train, which is somewhere in the desert behind a derailment and is more hours late than the railroad agent has yet been willing to admit, and this story comes to an end here to enable the writers to go out and see Bradley Stoughton play ball, the trip having been the most remarkable and successful in the history of the Institute.

Smelting Practice at Clifton*

SYNOPSIS—Eight coal-fired Herreshoff furnaces calcine from 65 to 80 tons each per day. Matte smelting is conducted in three reverberatories with 22x100-ft. hearths. Direct charges constitute 75% and fettling material 25% of the total charge. Coarse-crushed fettling material of 2½-in. diameter is piled up to the roof charging holes and reposes at an angle of about 45°. Matte from the reverberatories is blown in three 12-ft. converters of the Great Falls type and the copper cast in casting machines.

Previous to the construction of the new smeltery finished in February, 1914, the average annual production of the Arizona Copper Co. for 10 years ended with 1914 was 32,665,905 lb. of copper. Some idea of the recent growth of plant output is gained from the statement that the production for four months up to June of 1916 was 15,964,840 lb., while for June alone it was 4,900,000 lb.

Complete details of the movement of materials within the plant are best obtained from the flow sheet, Fig. 1.

Roaster equipment consists of eight Herreshoff furnaces with steel shells 21 ft. 7 in. in outside diameter. The first nine concrete hearths built were reinforced with iron rods laid in the top and bottom courses. Reinforcing in those with inner drop holes weighed 3,093 lb., and those with outer drops 2,148 lb. When fully heated, the fourth and fifth hearths, with heavy reinforcement, rose 6 in. at the center of the arch, which necessitated chipping off some of the concrete from the center of the hearths. In later construction ½-in. diameter reinforcing rods were used. This reduced the weight of iron to 1,172 and 1,373 lb. respectively for inner and outer drop hearths.

Slag-Concrete Hearths Satisfactory

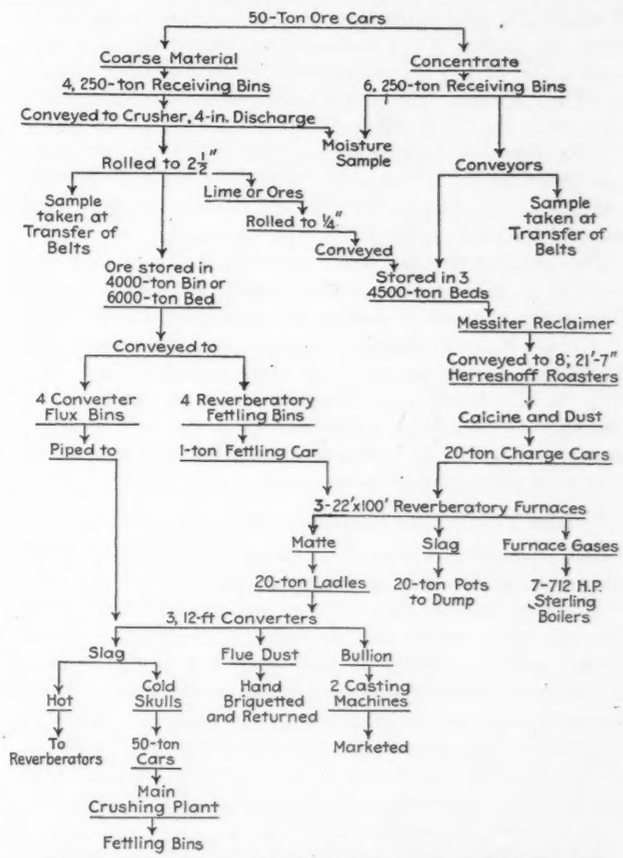
Slag-concrete hearths are preferred, providing the slag is highly siliceous. All concrete hearths have given entire satisfaction. They have been in service since May 3, 1914, without any repairs.

Provision is made for cooling the central columns and rabble arms with air supplied from a motor-driven fan, but during the last 18 months cooling air has not been required.

The roaster charge has varied from ore, limerock, and concentrate mixtures with 19.2% sulphur and 10.7% copper, to all concentrates with 30.7% sulphur and 15.8% copper, with fuel requirements varying from a maximum of 40 lb. of coal per ton of calcines to none when roasting all concentrate. The units of sulphur burned off have ranged from 7.5 to 17.4, the usual practice being to leave equal quantities of sulphur and copper in the calcine, because of the oxidized ore used in reverberatory fettling.

Heavy crude oil was first used as fuel, but with poor results, because with the low draft maintained burners could not be obtained of suitable size to burn continuously the small quantity of oil necessary to furnish this deficiency of heat and distribute it properly over the hearth. The flame was admitted through one door on the third or fourth hearth from the top. A burner that would stay lighted in these comparatively cold hearths produced an intense flame, and if kept running long enough to ignite the charge to the temperature desired, the brick hearth over the burner became too hot and the charge fused on the hearth directly in front of the burners. Calcine produced was not uniform, because the sulphur had to be controlled by burning oil intermittently, which resulted in first a hot furnace and low sulphur, then a cold furnace with high sulphur.

Coal-fired dutch-ovens with 12 sq.ft. of grate area have been adopted for supplying additional fuel required for roasting. Two ovens for each furnace admit the flame on the fifth hearth from the top. With these the roast can be quickly and closely regulated, and the furnace repairs have been greatly reduced as compared with oil-burning conditions.



FLOW SHEET, ARIZONA COPPER CO. SMELTERY

Ignition usually takes place on the fourth hearth from the top, and the temperature of the charge rises to 1,200 or 1,300° F. on the two lower hearths. With one reverberatory running, each roaster operated normally makes 65 tons of calcine per day. When two reverberatories are taking charge, each roaster has to supply 80 tons of calcine. Results show that while removing the same units of sulphur per ton, a furnace will consume less coal per ton when producing 60 than when producing 80 tons of calcine. Monthly averages of 113 tons of calcine produced per furnace day show a very high coal ratio. Fur-

*Excerpt from "Smelting at the Arizona Copper Co.'s Works," a paper presented at the Arizona meeting of the A. I. M. E., September, 1916, by F. N. Flynn, superintendent of the smelting department, Arizona Copper Co., Clifton, Ariz.

nace dampers are kept closed just to the point of smoking. Gases leaving the furnaces first enter a hopper-bottomed header-flue, through which they travel at a velocity of 6 or 7 ft. per sec., at 325 to 425° F. temperature, and then pass into a large dust chamber. Dust recovered from this chamber amounts to 0.8 per cent. of the dry charge to roasters.

Matte Smelting in Oil-Fired Furnaces

Smelting for production of matte is all done in reverberatories, either one or two furnaces being operated as required. Three furnaces set parallel the long way and 26 ft. apart, each with a hearth area 22x100 ft., are available, one of these always being a spare. The hearth in No. 3 furnace is crushed silica fused in on a slag bottom. Furnaces Nos. 1 and 2 have hearths of crushed silica fused in on bottoms of broken quartz. Roofs were all originally built with 1 in. to the foot rise in the arch. When the roof of No. 1 furnace was rebuilt, the arch was given a rise of 1¼ in. to the foot. Six-inch holes, spaced on 24-in. centers, left in the roofs along the side walls and across the back, allow fettling material to be piped into the furnaces from trough-shaped bins built vertically over these holes. Five-inch diameter pipes on fettling bins are being changed to 8-in., to permit using coarser material without choking the pipe openings.

Two parallel charge tracks cross the furnaces near the back in a direction at right angles to their length. Fifteen-ton charges of calcine, at a temperature of 1,050 to 1,150° F., are dropped through one water-jacketed charge hole in the center of the roof on either track, but 90% of all charges are dropped from the back track. This part of the charge dropped through the roof is designated "direct charge." Of the total solid charge smelted 75% is introduced in this way.

Bad Results of Charging Cold Materials

Bad furnace conditions are always expected if such cold material as crude ore, slag or limerock of any size, or anything coarse, like siliceous ore agglomerated with converter slag, either cold or warm, is dropped as direct charge without mixing it well with hot calcine. Ore, limerock or clinker produces "charge floaters." Cold slag sinks and makes sticky furnace bottoms. When it is necessary to add cold or coarse material to the direct charge, the best results are obtained when they are well mixed with hot calcines, in the calcine charge cars, but better still in the roasting furnaces.

Bed mixtures to be roasted are made of the required composition to produce a slag, when smelted, in which the ratio of oxygen in acids to oxygen in bases will fall between 2 and 2.25. A vast difference, however, is found in the smelting properties of calcines made from these mixtures, regardless of the similarity between their analyses or the analyses of the slags they produce. Calcine made from concentrate or sulphide ores of ½-in. size smelts readily, whereas if the calcine is an artificial mixture made of siliceous oxidized ore crushed to this size and mixed with an excessive proportion of limerock, the charges melt more slowly. The results from the two following mixtures will fairly illustrate this point:

Class of Material	Mix 103 % of Total	Mix 120 % of Total
Sulphide concentrate	100.0	70.7
Siliceous ore, low sulphur	....	4.8
Siliceous oxide ore	....	12.9
Limerock	....	11.6
Total	100.0	100.0

	Analysis						
Mix No.	SiO_2, %	Al_2O_3, %	Fe, %	CaO, %	S, %	Cu, %	Oxygen Ratio
103	18.3	4.6	28.2	0.7	29.0	14.10	1.43
120	20.7	4.7	24.1	7.6	22.5	10.98	1.45

A daily average of 365 tons of calcine per furnace was smelted during the time that mix 103 was on the charge. In comparison, 200 tons per furnace day was barely maintained while the charge consisted of calcine from mix 120. The practice is to crush siliceous ore as fine as $\frac{3}{16}$ in. for roaster beds and endeavor to keep the sulphide material as high as 75% of the total bed mixture. Ore and limerock mixtures require a much higher oil ratio than calcine from straight concentrate.

In other words, the greatest percentage of oxidized material that is permissible to smelt in the reverberatory furnace is found to be:

	Tons per Furnace Day	%	
Direct charge	300	25	Oxidized ore and limerock
Fettling	100	100	Oxidized ore
Total	400	44	Oxidized ore equivalent

Above 44% oxidized ore, the charge could undoubtedly be better handled in a blast furnace. The charges spread better when the furnace is nearly full of matte, and also when the copper and sulphur in the calcine are equal. Matte under 40% copper is favorable for higher tonnage.

Ore and byproducts crushed to a 2½-in. size for fettling constitute the remaining 25% of the solid charge smelted. It is customary after each skim to feed these materials from bridge-wall to shaft in the following proportions:

Furnace	Section No.	%	Material
Back	1	25	Old smelter slag Converter slag skulls
Back	2	50	Less siliceous ore
Middle	3	12	Less siliceous ore
Middle	4	8	Less siliceous ore
Front	5	4	More siliceous ore
Shaft	..	1	Silica

	Analysis							
	SiO_2, %	Al_2O_3, %	Fe, %	CaO, %	MgO, %	S, %	Cu, %	Oxygen Ratio
Converter-slag skulls	19.6	3.9	47.2	0.9	..	3.6	9.00	0.89
Old smelter slag	37.2	8.9	22.0	10.3	5.2	0.3	3.56	2.12
Less siliceous ore	42.6	7.7	18.0	3.0	2.5	1.0	6.80	3.74
More siliceous ore	65.0	12.2	5.6	0.8	0.6	1.9	3.78	19.43
Silica	84.4	6.3	3.1	0.5	..	2.6	0.74	46.34
Approximate average	40.4	7.5	21.5	3.5	2.4	1.3	6.49	3.08

Prior to July, 1914, the height of fettling was carried not to exceed 6 in. above the slag line. This height was gradually increased until October, 1914, when the practice of fettling to the holes in the roof was commenced and later successfully adopted after the size of fettling material was increased from ¾ in. to the present 2½-in. size. The coarse size stands better. It reposes at an angle of 45° above and 45° to 60° below the slag line.

The results achieved in performing fettling operations as practiced here depend upon the relative location and manner in which the material is dropped, as well as the amount of fines in it and its chemical and physical composition, as may be concluded from the following account of experience with different fettling materials.

Slag and byproducts, crushed fine, work unsatisfactorily in any part of the furnace. However, if crushed coarse, results are good when such material is charged in the back of the furnace.

Less siliceous fine ore is not good fettling in any place in the furnace. It does not stand, and requires care to keep it from running out into the furnace. Crushed coarse, it makes good fettling wherever used.

More siliceous fine ore mixed with coarse byproduct makes a bad combination. The only place the more siliceous fine ore alone can be used with any degree of success is on the bridge-wall.

More siliceous coarse ore is not so acceptable as less siliceous coarse ore, except in the front half of the furnace, because it makes too much siliceous scum on top of the slag.

Coarse raw concentrate is good in the back half of the furnace, but does not stand so well nor so high as coarser material. It gives bad results in the front half because it melts easily to a magnetic mush.

Fettling with hot calcine can only be done with any degree of success in Section No. 1, and then only slightly above the slag line. At that elevation it runs out over the furnace bottom. An attempt was made to fettle the entire furnace with calcine, but was abandoned when the tonnage dropped to less than half capacity. Calcine gave poorer results than any other material experimented with.

Pyrite in the front half melts easily to a magnetic mush. In the back half when mixed with siliceous oxide ore it works well.

The ideal fettling material was found to be less siliceous copper-sulphide ore containing 5 to 10% sulphur.

In other words, basic or sulphide materials are charged near the firing end because of their lower fusing points. If charged in the front portion, where the temperature is lower, they melt with sufficient ease to make a thick, mushy, semifused slag, and in the case of pyrite make quantities of magnetite. Siliceous ores with 60% silica produce a scum which blankets the slag and causes higher oil ratio and lower tonnage. If the siliceous ores contain much copper in oxidized form, the scum will assay from 0.7 to 1.3% copper, whereas if the copper is present, as a sulphide the scum will assay much lower.

The most important development as regards fettling has been along the line of coarser crushing and greater height of material to protect the side walls without encroaching on the furnace bottom area.

Oil-Firing Reverberatory Conditions

Fuel is 14 Bé, 18,000 B.t.u., California crude oil, pumped at 120 lb. pressure and delivered through steam heaters at a temperature of 170° F. to six burners and atomized with converter air. Two hundred and forty to 365 bbl. of oil is burned per furnace-day. This variation covers a one-furnace schedule when hard firing for high tonnage is required, or two furnaces with light firing and correspondingly low tonnage smelted.

Furnace-throat draft (inside the furnace) is 0.12 to 0.16 in. of water, and in header-flue common to all furnaces, draft is 0.50 in. water. Gases leave the furnaces at temperatures from 1,800 to 2,000° F. Seven Stirling boilers are available for reverberatory waste heat, each 712-hp. capacity, and all connected in multiple through cross-over flues from the header-flue.

Converter slag is poured through the back wall of the furnace, at the center, through a launder discharging at the height of the oil burners. Magnetite builds up under the discharge of the launder, but the bridge wall on either side of it requires fettling.

Real Fluxing Value of Converter Slag

Considerable has been written regarding the fluxing value of converter slag poured into reverberatory furnaces. The prevailing opinion seems to be that very little fluxing value is within one's control. It is argued that the basic converter slag does not act upon the charge resting on the slag surface, does not mix with the trisilicate slag, and passes through the furnace like a submarine as a monosilicate, emerging near the skimming end. The technical reason advanced for these arguments is the relatively high specific gravity of the basic converter slag. The writer has proved to his own satisfaction that practically all the iron present in liquid converter slag other than iron in the magnetic state is effective as flux. The effect of liquid converter slag was vividly shown on one occasion, when a furnace had been tamped with moist quartz from floor to roof along the walls, and when fused was largely filled with hot converter slag and little regular charge. Within 24 hours there was little quartz remaining.

The results given in Table 1 were selected for comparison because they show the extreme variation in the material treated in this department. Limited storage capacity at the smeltery required two furnaces to be operated a part of the time to handle receipts. Additional charge needed for the month that two reverberatories were operated was composed of siliceous oxidized ores and limerock, and represents a temporary condition. The concentrator additions, now almost finished, will in the future supply sufficient concentrates to make the proportions of total material treated fall somewhere within the percentage limits given in the examples.

TABLE 1. REVERBERATORY-FURNACE CHARGE DATA

	One Reverberatory	Two Reverberatories
Dry tons direct charge per furnace-day	402.5	262.7
Dry tons fettling per furnace-day (ores)	84.9	65.7
Dry tons fettling per furnace-day (byproduct)	25.0	38.7
Dry tons total solid charge smelted per furnace-day	512.4	367.1
Percentage of fettling to total solid charge	21.45	28.3
Analysis of direct charge:		
SiO_2, %	19.8	21.7
Al_2O_3, %	5.4	4.9
Fe, %	32.3	26.6
CaO, %	2.3	7.7
S, %	13.7	13.6
Cu, %	15.55	13.24
Oxygen ratio	1.32	1.41
Analysis of fettling (ores and by-products):		
SiO_2, %	38.8	39.5
Al_2O_3, %	7.6	8.0
Fe, %	23.4	25.5
CaO, %	1.7	4.0
S, %	9.1	3.0
Cu, %	6.65	5.52
Oxygen ratio	3.36	2.93
Total tons hot converter slag to reverberatories	2,419.00	2,862.00
Analysis of reverberatory slag:		
SiO_2, %	35.6	38.0
Al_2O_3, %	9.7	9.0
FeO, %	49.7	39.4
CaO, %	2.4	8.4
MgO, %	0.6	1.5
Cu, %	0.51	0.45
Oxygen ratio	2.04	2.06
Analysis of matte, % Cu	37.43	37.70
Matte fall, %	31.68	27.1
Sulphur volatilized in furnace, %	24.14	25.7
Bbl. oil burned per ton solid charge smelted	0.653	0.778
Bbl. oil burned chargeable to steam	0.315	0.349
Bbl. oil burned account smelting	0.338	0.429

Control of Magnetite in Matte Blowing

The production of magnetite in the converters is, within reasonable limits, controlled by the converting practice. The converter slag poured into the reverberatory furnace should not contain any magnetite visible to the eye. The safest practice is to reject the last 2 cu.ft. of slag when pouring. The rejected slag with the ladle skull will eventually enter the furnace as fettling material, where its detrimental effect to the furnace is temporarily turned to some good, because of its refractory properties. Its tendency to stick to the sides if mixed with cold ore is quite noticeable when the fettling bank

is removed from the walls with the furnace out of service. By this practice, magnetite is made to perform a somewhat similar service in the reverberatory furnace that it does in the protective coating in a basic converter. Unfortunately only a small portion of the total magnetite production can be so used.

Some metallurgists prefer to make a small quantity of magnetite on each converter charge, contending that in this way the coating remains of more constant thickness. They accomplish this by blowing a few minutes on the start or finish, either or both, but usually at the start, with a shortage of silica. It is believed that by intentionally making magnetite with every charge, the quantity made must be very large as compared with the small amount that can be made to stick to the walls by so haphazard a practice going on continuously. Our practice is to coat the shells when the lines of brickwork can be seen through the thin coating. And when a shell is being coated, no attempt is made to do anything with the matte other than form the coating. When coated, the magnetite and copper mush is dumped on the floor under the shell, and later it is charged in small quantities at intervals in other charges. When coated, a shell is never blown without a large excess of silica.

TABLE 2. CONVERTER-PRACTICE DATA

Converter Division	One Reverberatory	Two Reverberatories
Tons reverberatory not matte treated	5,293.0	5,903.0
Cu in reverberatory not matte treated, %	37.43	37.70
Tons siliceous ore used for flux	820.0	1,356.0
Analysis of siliceous ore used:		
SiO_2, %	64.5	65.3
Al_2O_3, %	10.6	11.6
Fe, %	5.2	5.7
CaO, %	0.2	0.5
S, %	0.5	1.7
Cu, %	6.45	4.29
Oxygen ratio	25.30	22.65
Analysis of converter slag produced, % SiO_2	19.6	19.6
Tons copper bullion produced	1,800.0	2,450.0
Cu in bullion, %	99.60	99.55
Tons copper produced per converter-day running time	43.9	51.4
Minutes blowing per ton copper	33.0	28.0
Average tons bullion per charge	6.429	8.524
Average time of blowing a charge	3 hr. 54 min.	3 hr. 59 min.
Tons cold new material treated per ton bullion	0.462	0.592
Tons cold byproduct re-treated at converters per ton bullion	0.849	0.577
Blast, pounds pressure	13.0	13.0
Cu.ft. air per converter per minute	6,738.0	5,445.0
Cu.ft. air per ton bullion produced	220,949.0	152,499.0
Cu.ft. air per ton iron and sulphur eliminated	135,043.0	96,145.0
Oxygen efficiency, calculated from blower displacement and requirements of Fe and S eliminated, %	60.63	84.09
Total Material Treated—All Divisions:		
Dry tons concentrates	13,227.0	13,360.0
Dry tons ores	4,069.0	7,303.0
Dry tons limerock	391.0	2,130.0
Dry tons new material, total	17,687.0	22,793.0
Dry tons byproducts treated at reverberatories	924.0	*2,317.0
Concentrates, % of total new material treated	74.78	58.62
Ores, % of total new material treated	23.01	32.04
Limerock, % of total new material treated	2.21	9.34

*Including reverberatory slag skulls.

The converting division is equipped with five 12-ft. Great Falls-type shells lined with magnesite brick; three converter stands, each operated by an independent motor (the fourth stand is under construction); two 40-ton cranes; two straight-line casting machines, each with 39 copper molds. Two stands are regularly used, for which air at 13 lb. pressure is supplied from the power house by two or three Nordberg blowing engines.

When converting matte of over 40% copper, only a small amount of cold matte shells and cleanings from the floor can be used; but with lower-grade matte, all matte shells, converter flue dust and any converter byproducts made except converter-slag skulls can be handled in this division.

Molten copper is transferred from converters to casting machines in cast-steel ladles lined with fines screened from ores regularly used as converter fluxes. Bars are cast in molds made of converter copper. A 1¼-in. cast-iron splash plate covers half of the bottom area, and an average of 73 tons of bullion is cast per mold. Bars weigh 240 lb. each, and 35 min. is required for casting a charge weighing 7 tons. Considerable chipping of bullion bars is necessary to remove edges and fine shot due to blowing to gas finish of 99.60% copper.

Data in Table 2 show the variation in practice depending on whether one or two reverberatory furnaces are in operation.

The Growth of the Globe District, Arizona

At the banquet to the visiting members of the A. I. M. E. at Globe, Ariz., on the evening of Sept. 22, Dr. Ricketts responded to the toast, "The Growth of the Globe District," and told in detail of the vast development of the section as a mining center. Dr. Ricketts said:

While copper and silver in the Globe district may have been known at an earlier date, the earliest actual records show that the Globe and Globe Ledge claims were located as silver mines in 1873. They were not worked, however, and in 1875 some rich silver mines were discovered, the Globe district was organized, and silver ores were milled and silver bullion shipped.

The first copper was produced at Wheatfields from ore from the Hoosier claim, which was smelted in Mexican adobe furnaces in 1878. The campaign was but a short one, and some 40 tons of black-copper pigs was the result. A little later on, John Williams, Sr., worked the Carrie mine and smeltery. His ore was a quartzite containing 6% copper and little or no iron. It is said that he purchased his flux from the big iron outcrop on the Globe claim and that he made a profit. Incidentally it is said that the only impurity in the hematite was red oxide of copper to the extent of about 25%.

This, it is said, was the discovery of the first important orebody in the district. This and other mining claims, consolidated into what is now known as the Old Dominion, were bought by Baltimore and Boston people and worked quite extensively, considering the fact that the coke had to be brought in from Willcox, 140 mi. distant, in wagons, and the black-copper pigs had to be hauled back.

My first visit to the camp was in 1890, when Dr. Douglas began the purchase of claims which later formed the United Globe mines. At this time Professor Walker was superintendent of the Old Dominion mine. A little later some rich and very siliceous and aluminous ores were found in the region near what is now the Miami camp. The Black Warrior shipped rich chrysocolla ore to the Old Dominion smeltery in 1895, and later the Keystone and Live Oak, which were located in about 1897, began to ship even more siliceous material to the same works.

The railway from Bowie, several years in building, reached Globe in the latter part of 1898.

In 1903 the Old Dominion Copper Mining and Smelting Co. of New Jersey was practically bankrupt. The Old Dominion Copper Mining and Smelting Co. of Maine was formed and acquired most of the stock of the New Jersey company and all the stock of the United Globe mines. In exchange for the latter stock and with treasury stock bought for cash, gentlemen associated with Phelps, Dodge & Co. took control. A

more liberal policy was adopted, profits for the time being were put back into the mine and works, and in four years' time the stock rose from less than $5 to over $60 per share. Ever since that time this mine has been prosperous and profitable, and in your visit you noticed the splendid shape it is in and the great ability of the management.

Returning to the new district near Miami, in 1903 and 1904, Mr. Coplen, in behalf of himself and others, bonded and purchased a few mining claims, which became the beginning of the Inspiration group, and he opened up a small block of lean disseminated ore. In 1907, J. Parke Channing bonded the Miami group of claims and developed for himself and his principals the great Miami mine.

Shortly after others purchased the Coplen property and many other claims and formed it into the Inspiration Copper Co. and started development on a considerable scale. Hovland and Smith also took over the Live Oak group of claims and likewise began development; while parties affiliated with the Miami shareholders took over the Keystone group. The Miami company, after developing their mine, undertook the construction of their splendid plant, which up to that date excelled anything that had ever been built. As it was necessary for them to sell their concentrates they made a long-time contract with Cananea on very favorable terms. A little later, in 1911 as I recall it, the International Smelting and Refining Co. closed a long-time contract for Inspiration concentrates, and later on interests affiliated with this company purchased the Live Oak group and consolidated with the Inspiration Copper Co. into what is known as Inspiration Consolidated Copper Co. This consolidation occurred in March, 1912, and C. E. Mills accepted the management of the property.

At first it was planned to use gravity concentrates, and construction was begun on a building designed for that process. Late in 1912, however, Dr. Gregory, of the Minerals Separation Co., advised us that his firm had had splendid results on our ore in their laboratory by flotation. It was therefore arranged that he was to send us a 50-ton machine to Inspiration. Dr. Gahl's most able paper[1] tells the rest of the flotation story.

After taking the two long-term contracts from Miami and Inspiration, it became evident to the companies interested that the high freight rates to Cananea made it desirable to provide local treatment, and the International smeltery now in operation at Miami was decided upon and built.

In 10 short years the output of the Globe district has sprung from about 30,000,000 lb. of copper a year to about 230,000,000 lb. a year, and the works you have seen today have been put in operation.

In closing this history, gentlemen, I cannot help telling an anecdote. Both Mills and I once worked for Phelps, Dodge & Co. for many years. For some reason many believe that I still work for them, though I left those good friends 10 years ago. Today I met a gentleman who knew us both in the old days, and we were looking over the splendid work at Inspiration, when he said. "What I can't understand is, how did you let Mills get away from you?" Gentlemen, I had not overlooked a bet. Referring to the puns of a newspaper cartoonist, I had early felt that Mr. Mills was indubitably to be a "spire" in Inspiration.

Gold Dredging in Montana

The history and development of the gold-dredging industry in Montana is dealt with in a comprehensive manner by Hennen Jennings in a paper recently published by the Bureau of Mines.[2]

The evolution of design, from the type of spoon dredges operated by hand in New Zealand as early as 1865 to the modern high-powered dredge with close-connected buckets of large capacity, is briefly but clearly described; the limitation of text in this respect being more than compensated for by the judicious selection of illustrations.

Due credit is given to California as the state which by seniority and production holds first place in American gold dredging, with a yield of about $71,000,000 to the end of 1914; and the claim of Montana as the holder of second place, with a yield of about $6,800,000 to the end of 1914, is well supported.

The rush of miners to Alder Gulch in the early 60's; the skimming of the richest gold deposits by pan, rocker and sluice; the robbers and activities of the Virginia City vigilance committee; the more prosaic gleaning of the second harvest of gold by ground sluices and other means; and finally the advent of the corporation dredges, working with cold-blooded mathematical precision on areas of predetermined value—all these are more or less vividly portrayed.

A large part of the paper is devoted to the operations of the Conrey Placer Mining Co., which constitute an important factor in the development of gold dredging in Montana. Statistical details, cost data and recovery figures are given, chiefly in tabulated form, which will doubtless be of much value for comparison and as an aid to future design. The paper concludes with a summary of other dredging activities in Montana, a glimpse of possibilities in South America, and a few general remarks, supplemented by a selected bibliography of dredging.

Following Mr. Jennings' paper is a chapter by Charles Janin, on "Placer-Mining Methods and Operating Costs," describing many operations employed in different parts of the world for the recovery of placer gold.

Japanese Mineral Production

One of the features of the report on Japanese exports and imports for the first six months of 1916 is the evasion of specific information concerning the imports of lead and zinc ores and exports of their corresponding metals. In the accompanying table, imports of these ores are lumped together with those of other ores and the value of the total is given as "ores except iron." Exports of the metals are likewise lumped as "all other metals except iron and brass."

The figures of the following table are according to the monthly returns of the foreign trade of Japan published by the Department of Finance.

JAPANESE EXPORTS AND IMPORTS OF ORES AND METALS FOR SIX MONTHS OF 1916

	First Half 1916	1915	1914
Imports:			
Ores except iron, value in yen	6,748,596	248,446	196,049
Lead, ingots and slabs, M tons	11,649	6,644	7,267
Zinc, ingots and slabs, M tons	1,707	1,688	2,137
Zinc, sheets, M tons	78	280	1,967
Tin, ingots and slabs, M tons	389	677	575
Brass and bronze, M tons	21,121	580	90
Exports:			
Zinc ores, M tons	1,579	3,136	.....
Other ores, value in yen	1,452,000	342,537	.....
Copper, ingots and slabs, M tons	25,711	30,072	.....
Antimony, M tons	6,065	4,151	1,158
All other metals except iron and brass, value in yen	10,955,168	1,167,089	334,450

Uranium as a Substitute for Tungsten in making high-speed tool steel has been the subject of tests made by the Standard Chemical Co., Pittsburgh. Some results of these tests are reported to the "Iron Trade Review" by the company. One tool, fed at the rate of $\frac{1}{8}$ in. per revolution at a cutting speed of 74 ft. per min., with a cut $\frac{5}{8}$ in. in depth, went a distance of 12 in. before regrinding was necessary. A tool turning a locomotive crank pin, operating at a speed of 103 ft. per min., with a feed of $\frac{3}{32}$ in. and cut $\frac{5}{8}$ in. in depth, went 8 in. before it was reground. On a locomotive axle, a tool with a $\frac{1}{16}$-in. feed and a cutting speed of 75 ft. per min., went a distance of 14 in. on the first and 3 in. on the second lap before it was reground. The depth of the cut on this axle, according to the Standard company's report, was $\frac{1}{4}$ in. On a 12-in. shaft, 22 ft. long, a tool fed at a rate of $\frac{1}{8}$ in. to $\frac{1}{10}$ in., at a speed of 38 ft. per min., with a depth of cut $\frac{1}{2}$ in., went 127 in. It took three hours to conduct this test. After the tool had gone 105 in., the cutting speed was increased to 65 ft. per min.

[1] "History of the Flotation Process at Inspiration," by Rudolf Gahl, Bulletin, A. I. M. E., September, 1916.

[2] Bulletin No. 121, U. S. Bureau of Mines, "The History and Development of Gold Dredging in Montana, with a chapter on Placer-Mining Methods and Operating Costs." (Papers read at the Second Pan American Scientific Congress held in Washington, Dec. 27, 1915, to Jan. 8, 1916.)

Mineral Production of Ontario

The returns of production for the first six months of 1916, made to the Ontario Bureau of Mines by the metalliferous mines and works of the province, are summarized in the accompanying table, which also gives comparative quantities and values for the corresponding period of 1915:

SUMMARY OF ONTARIO MINERAL PRODUCTION

	Quantity		Value	
	1915	1916	1915	1916
	Oz.	Oz.		
Gold	173,021	235,060	$3,570,072	$4,822,740
Silver	11,101,909	10,267,743	5,188,763	6,188,269
	Lb.	Lb.		
Copper	.....	77,795	.....	14,368
Cobalt (metallic)	.....	121,817	.....	103,677
Nickel (metallic)	.....	13,933	.....	5,899
Molybdenite (concentrates)	.....	12,631	.....	13,075
Cobalt and nickel oxides	141,500	401,408	56,812	204,638
	Tons	Tons		
Copper in matte	8,523	11,426	1,704,600	2,285,096
Nickel in matte	15,182	20,651	7,591,000	10,325,766
Iron ore	134,077	80,698	288,296	243,268
Pig iron	225,940	295,349	2,856,040	4,424,496

The production for the six months ended June 30, 1916, shows a material increase in value of all metals over that for the first six months of 1915, with the single exception of iron ore.

If the present rate of production of gold is maintained, Ontario should reach the $10,000,000 mark for 1916, as compared with $8,500,000 for 1915. Of the total yield the Porcupine camp contributed all but $545,434 produced by the Crœsus in Munro township, the Rognon near Dryden, the Tough Oakes at Kirkland Lake and the Canadian Exploration Co., at Long Lake, near Sudbury. The Hollinger Consolidated and Dome mines are the big producers of the Porcupine camp. Before the year is out Boston Creek will probably be contributing to Ontario's gold production. Development is proceeding on some of the more promising claims at Kowkash, east of Lake Nipigon on the National Transcontinental Ry.

Since the beginning of 1916 the price of silver has advanced considerably, the average being 62½c. per oz., low 56½c. and high 77¼c. As a result production has been stimulated, and the value, as compared with 1915 figures, shows a considerable increase. Although the ounces sold were less than for the corresponding six months' period of 1915, the total production was greater, over 1,000,000 oz. remaining to be marketed. Undoubtedly the life of the Cobalt camp will be prolonged as the result of introducing flotation treatment for handling low-grade dumps and slimes. Nipissing still leads in output, with a valuation of $1,766,561. The Mining Corporation of Canada (Cobalt Lake and Townsite City) is the next large producer, followed by Kerr Lake, Coniagas, McKinley-Darragh-Savage, Seneca-Superior, etc., in the order named.

With the outbreak of war the European market for cobalt oxide was suddenly cut off. However, new markets and new uses for the metal have improved the situation. High-grade steels are now produced from cobalt alloys. Metallic cobalt production is greatly in excess of last year.

Nickel and Nickel-Copper Compounds

Metallic nickel from Cobalt ores is produced at the refining works of the Deloro Smelting and Reduction Co., Ltd., formerly known as the Deloro Mining and Reduction Co. The output shows an increase over the 1915 production, which was not marketed during the six months' period under consideration.

Apart from the nickel-copper deposits of Sudbury, there has been a revival of copper mining in Ontario, partly due to the high price of the metal. The old Tip Top mine and other properties near Mine Centre, in the district of Rainy River, are now producing. The Rand Syndicate is operating near Timagami. The Sable River Copper Co. at Massey has erected a mill and is using the flotation process for the treatment of copper ore.

The smelteries of the Canadian Copper Co. at Copper Cliff and the Mond Nickel Co. at Coniston are turning out nickel-copper matte at an unprecedented rate. The production, as compared with the first six months of 1915, shows an increase of nearly 40%. The valuation of the metallic contents of the matte has been made on a basis of 10c. per lb. for copper and 25c. for nickel. The figures given for metallic copper and nickel separately show that the prices were over 18 and 42c. per lb. respectively.

In addition to the companies mentioned the Alexo mine, near Porquis Junction, produces a small amount of nickel-copper ore, which is treated at the Coniston smeltery.

Molybdenite occurs widely in Ontario, but is mined chiefly in Renfrew County. It is wanted at the present time for use in the manufacture of high-speed tool steel, and for this purpose molybdenum will probably replace tungsten to some extent. The demand for molybdenum steel to be used in munition factories comes largely from the allied nations, Great Britain, France and Russia. Molybdenite concentrates containing 85% or more of MoS_2 are worth about $1 per lb. Ferromolybdenum is now (September) being manufactured for the first time in Canada by the Orillia Molybdenum Co. at Orillia, and the Tivani Electric Steel Co. at Belleville.

The only shipments of iron ore were from the Magpie mine, operated by the Algoma Steel Corporation, of Sault Ste. Marie. Although iron-ore production shows a decrease as compared with the same period in 1915, that of pig iron shows a material increase.

Mineral Production of Peru

In an address of the President of Peru, delivered before the Peruvian Congress on July 28 last, the following information regarding mineral production in 1914 and 1915 was given (*U. S. Commerce Reports*, Sept. 25, 1916), the figures in parentheses being for 1914: Copper, 34,319 metric tons (27,090); petroleum, 285,000 metric tons (252,666); silver, 293,000 kg. (286,600); gold, 1,670 kg. (1,500); coal, 289,000 metric tons (283,860); vanadium ore (45%), 3,145 metric tons (14); tungsten ore (65%), 371 (196); lead, 2,750 (3,048); salt, 25,729 (25,933); antimony ore (45%), 406; molybdenum ore (82%), 274 metric tons; mercury, 700 kg. (700); zinc, 19 metric tons.

In 1914, 11,187 kg. of bismuth and 1,236 metric tons of borates were produced, but there was no production of these in 1915. The value of the mineral production was $26,324,008 in 1915 and $20,285,932 the preceding year.

Clay Mining in the United States flourished in 1915. Curtailment of American imports of high-grade fire clay from Germany as a result of the war in Europe seriously affected the manufacture of crucibles and lead pencils in this country. The United States Geological Survey, in reporting this state of affairs, says that efforts were successful in locating a domestic supply of clays suitable for use in these industries in Arkansas, Illinois, Missouri and Ohio. The imports of clay decreased considerably in quantity and value, and were the smallest in quantity since 1908 and the lowest in value since 1905.

Motor-Truck Operation in Arizona*

Two Alco 3½-ton motor trucks were used by Young Bros. while operating at the Mammoth Collins mine at Shultz, Ariz. One was equipped with an oil tank holding 1,075 gal. The other was fitted with a stake body and used to carry machinery, wood, rails, pipe and all classes of miscellaneous supplies. The bodies were made of oak with maple flooring and were attached to the frame of the chassis by U-bolts, to avoid drilling the main members of the frame.

Most of the hauling was done from Tucson, a distance of 47½ mi. During the first three months, part of the road was in bad condition and the tire cost was excessive. After this part was repaired, the road was in fair condition, but never good. There were no excessive grades or bad sand, but wagon ruts, too narrow for the truck wheels and of a different gage, caused heavy tire loss; while chuck holes, sharp curves and stones, both embedded and loose, were objectionable features. During wet weather the trucks could not get sufficient traction to climb some of the hills and were likely to stick in the mud in certain places, so that no attempt was made to run them unless they were on the road when the rain started. This lost time amounted to about 5% of the total, but whenever possible, it was utilized in making minor repairs.

The price of gasoline was from 17 to 21c. per gal. Rubber tires were used throughout. Drivers were paid $4.50 to $5 per shift, and a return trip to Tucson was counted as two shifts even when made in one day. Drivers were provided with a room in Tucson and were paid for all time lost due to causes beyond their control. Trucks were loaded one way only.

Speedometers were placed on both trucks, but the excessive vibration soon caused them to fail. For this reason and because no account was taken of the distance covered in picking up a miscellaneous load or in other minor ways, the mileage given is under the actual distance traveled. Some of the weights had to be estimated, but

MOTOR-TRUCK OPERATING DATA

Total distance traveled by trucks, mi.	23,000
Total work done by trucks, ton-miles	42,700
Average distance covered per gal. gasoline, mi.	4.5
Average distance covered per gal. lubricating oil, mi.	128
Average speed, loaded, mi. per hr.	7
Average speed, light, mi. per hr.	7.8

DETAILS OF COSTS OF OPERATION

	Total Cost	% of Total	Per Truck-Mile	Per Ton-Mile
Wages of drivers	$2,623.32	23.91	$0.1141	$0.0614
Wages of helpers	286.50	2.62	.0125	.0067
Repairs, labor	581.74	5.30	.0253	.0136
Repairs, lost time	156.15	1.42	.0068	.0037
Oils, grease and waste	379.17	3.46	.0165	.0089
Gasoline	1,610.49	14.68	.0700	.0377
Tires	2,445.75	22.30	.1063	.0573
New parts	515.08	4.69	.0224	.0121
Miscellaneous supplies	348.82	3.18	.0152	.0082
Incidental expense	226.21	2.06	.0098	.0053
Depreciation	1,796.80	16.38	.0781	.0421
Total	$10,970.03	100.00	$0.4770	$0.2570

care was taken to have the number of ton-miles low rather than high, to avoid underestimating the costs. The cost of hauling from Tucson to the mines was $12 per ton with the trucks, while the best possible team price was $15. Teams made one return trip a week, while the truck regularly made one in two days and could always, and many times did, do it in one day. The loss of time due to wet weather would be about half as much with teams as with trucks.

The table of detailed costs given covered the period from Aug. 21, 1913, to Aug. 15, 1914, the only time in which the trucks were continuously employed. From Aug. 15, 1914, to Mar. 30, 1916, they were used intermittently, but the figures for this period have been excluded as not being representative. If included, they would somewhat lower the cost per ton-mile. Just prior to the close of the period covered by the cost figures, the trucks were overhauled and put in good condition; new rear wheels were put on and new tires secured. The cost of all this was charged to operation. Allowance for extra tires on hand would reduce the cost per ton-mile approximately ¾c., leaving a net cost of about 25c. With loads on the return trip this cost per ton-mile would be lowered at least 40%.

*Excerpts from an article on "Motor-Truck Operation at Mammoth Collins Mine, Shultz, Ariz.," by Wilbert G. McBride, Long Beach, Calif., presented at the Arizona meeting of the A. I. M. E., September, 1916.

Malay States Metal Exports

The exports of block tin from the Federated Malay States for June, 1916, amounted to 6,258 piculs (picul = 133.5 lb.), compared with 5,599 in June, 1915. Exports of tin ore (70% of gross weight) amounted to 51,448 piculs, compared with 62,404 in June, 1915, according to *Daily Commerce and Trade Reports*. Exports of block tin for the first six months of 1916 amounted to 39,119 piculs, compared with 34,282 in the corresponding period of 1915. Exports of tin ore amounted to 325,863 piculs, compared with 357,455 in the first six months of 1915.

Exports of wolfram from the Federated Malay States for June, 1916, amounted to 370 piculs, producing a total for the year to date of 2,795 piculs, compared with 1,917 during the corresponding period of the preceding year. Exports of gold for June, 1916, were 1,170 oz., producing a total to date of 8,074 oz.

The Nation and Its Engineers

Appreciating the benefits that might come from the close coöperation of the country's engineers and the administrators of the Government, representative engineers gathered at a luncheon at India House, New York, on Sept. 28, to discuss the possibilities of taking some action. One of the plans proposed was to form a separate organization for the purpose of bringing the engineer forward to a position of influence in the affairs of the Government. One of the principal necessities is to advise Congress concerning engineering questions, upon which it cannot be expected to be well informed. The problems of civilization are becoming more and more technical in their character. The United States is growing as a great industrial nation. The engineer has been modestly keeping himself in the background, though he is the prime factor in the industrial progress of the country. As such he should be a directing factor.

The engineers present at the luncheon included: Clemens Herschel, president, American Society of Civil Engineers; Dr. Charles L. Parsons, secretary, American Chemical Society; Dr. H. S. Drinker, president, Lehigh University; C. F. Rand, E. G. Spilsbury, W. S. Gifford, Frank J. Sprague, Dr. L. H. Baekeland; H. W. Buck, president, American Institute of Electrical Engineers; Calvin W. Rice, secretary, American Society of Mechanical Engineers; L. P. Alford, editor, *American Machinist*; W. R. Ingalls, editor, *Engineering and Mining Journal*:

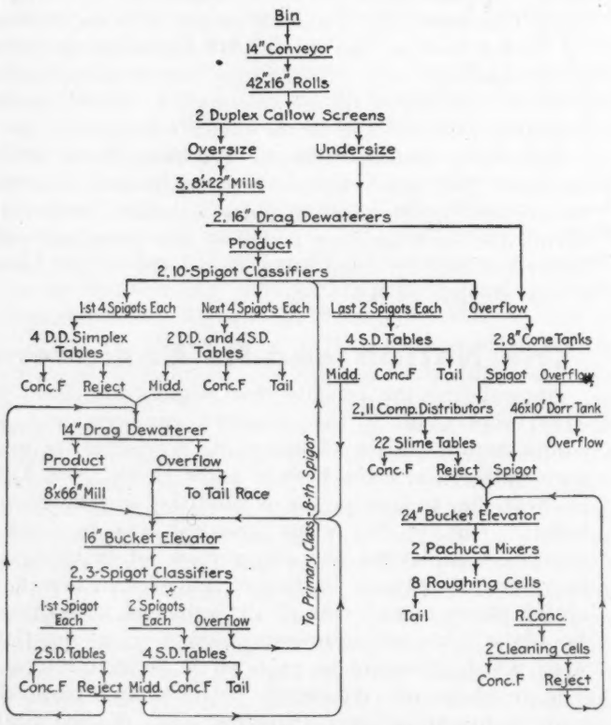
Charles Whiting Baker, editor *Engineering News;* Alvin I. Findley, editor, *Iron Age;* J. Merritt Matthews; E. J. Mehren, editor, *Engineering Record;* Dr. A. R. Ledoux; F. L. Hutchinson, secretary, American Institute of Electrical Engineers; Dr. D. S. Jacobus, president, American Society of Mechanical Engineers; Thomas Robins, Lawrence Addicks; Dr. Charles H. Herty, president, American Chemical Society; Charles Warren Hunt, secretary, American Society of Civil Engineers; Gano Dunn, Grosvenor Clarkson, W. L. Saunders.

The action taken consisted in authorizing the appointment of a committee of five to consider ways and means. No announcement has yet been made of the personnel of the committee.

Miami Copper Co. Data

The Miami Copper Co. presented to the members of the A. I. M. E., at the time of their recent visit to Arizona, a pamphlet containing many data of interest regarding their operations.

Haulage levels are developed 150 ft. apart vertically. These consist of drifts 7x8 ft. in the clear, placed 50 ft.



FLOW SHEET OF MIAMI MILL

apart horizontally. Of a present daily production of 5,455 tons, 1,506 tons is procured from top-slicing, 3,518 tons from shrinkage stoping and 431 tons from development work. A total of 639 men are employed on the surface and underground to mine this, making a production of 8.54 tons per man. The haulage levels are laid with 45-lb. rails at 24-in. gage. Trains of 30 to 40 cars having a capacity of 3⅓ tons each are hauled by 6-ton electric locomotives. The ore is dumped into bins on each level and hoisted to the surface in 7½-ton skips operating in balance in a four-compartment shaft. Two compartments are used for the skips, one for a cage for handling men and supplies and one for a ladderway and pipeway. This hoist has a capacity of 500 tons per hr. Artificial ventilation is required and is supplied by two 60,000-cu.ft. fans.

In the coarse-crushing department the ore is dumped into a bin of 1,000 tons' capacity and from there over a grizzly having a 2-in. opening. The oversize goes to a Kennedy No. 7½ gyratory crusher, where a reduction to 3½ in. occurs. A trommel 4 ft. diameter and 10 ft. long, with manganese screen having a ¾-in. opening, removes the undersize. Traylor 55x20-in. rolls operating at 100 r.p.m. reduce all material to 2 in. Secondary Traylor 42x16-in. rolls operating at 115 r.p.m. effect a final reduction to ¾ in. Trommels 4 ft. diameter and 7½ ft. long with ¾-in. opening return any oversize to the circuit. An inclined elevator 30 in. wide 258 ft. long, having an inclination of 3½ in. per ft. and operating at a speed of 460 ft. per min., carries the crushed ore to a horizontal conveyor 30 in. wide 329 ft. long running 360 ft. per min., which distributes it to a series of cylindrical mill bins having an aggregate capacity of 11,000 tons.

In the fine-crushing department an inclined conveyor 14 in. wide 25 ft. long running at 200 ft. per min. takes the feed from the mill bins and delivers the ore to 42x16-in. Traylor rolls. Crushing has been dry to this point, at which water is added in the proportion of ½ ton to 1 ton ore. The steels on these rolls have a life of 101 days. The roll product goes to Callow screens, opening 0.029 in.; 20% goes through. The screens have an efficiency of 60% and a life of 53 days. Hardinge mills 8 ft. by 22 in. operated at a speed of 21 r.p.m. by a 150-hp. motor continue the reduction process. Pebbles to the extent of 1.14 lb. per ton of ore are used in some of the mills. Others use 2-in. manganoid-steel balls in the ratio of 1.21 lb. balls per ton of feed. The ore ground per mill per day with balls is 284 tons, while that ground with pebbles is 174.

Secondary Hardinge mill reduction is accomplished in 8-ft. by 66-in. mills operated by 75 hp. motors at 28 r.p.m. for the pebble mills; 250 tons of feed per 24 hr. is accommodated with a pebble consumption of 0.44 lb. per ton of feed. The ball mills are actuated by 150-hp. motors at 20.5 r.p.m. with a feed of 330 tons per 24 hr. and a steel consumption of 1.03 lb. per ton of feed.

In the flotation department 0.43 lb. oil is used per ton of ore. The oil mixture at present is composed of 50% coal tar, 35% creosote, 10% pine oil and 5% cresol.

During the first half of 1916 an average daily tonnage of 4,722 was treated running 2.09% copper. Of this amount 74.06% was recovered, leaving 0.56% in the tailings, which are being stored for future re-treatment. The concentrate runs 41.74% in copper. A total of 12.97 kw.-hr. is used per ton of ore milled. There are 209 men employed in the milling process, which is equivalent to 22.62 tons per man.

Total water requirements are 1,428 gal. per ton, of which 1,096 gal., or 76.8%, is reclaimed from previous use. This is equivalent to a fresh-water requirement of 332 gal. per ton.

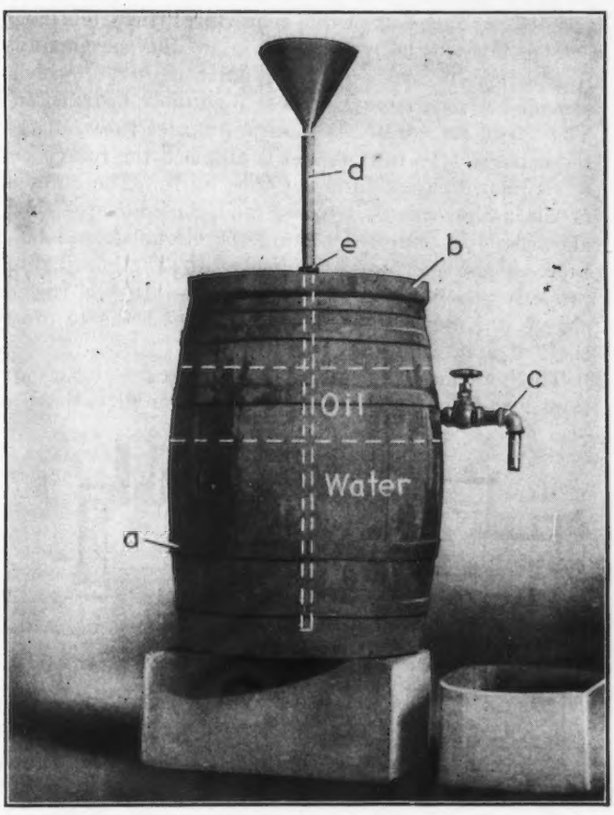
The Refractoriness of Fireclay lowered directly as the superimposed weight upon the clay, according to recent experiments by J. W. Mellor and B. J. Moore ("Trans. Eng. Ceram. Soc.," Vol. 15, p. 117). The advisability of making firebrick carry as little load as possible is thus emphasized.

Details of Milling and Smelting

An Effective Oil Filter

By Walter S. Weeks*

A great deal of lubricating oil is often lost about the engines and compressors of a mine because of the absence of an oil filter. A simple and effective filter may be made as shown in the illustration, in which *a* is a small barrel or tank, *c* is a faucet three-fourths of the way up from the base, *b* is a wooden cover through the center of which



A BARREL OIL FILTER

is inserted an iron pipe *d* extending to within 3 in. of the bottom of the barrel. The pipe is held in place by the collar *e*.

The barrel is half filled with water. The dirty oil is poured into the top of the pipe through a funnel. The dirt settles to the bottom of the barrel while the cleaned oil rises to the top of the water and can be drawn through the faucet. The pipe should extend a foot or so above the top of the barrel to afford a sufficiently long column of oil to balance the head of oil and water in the barrel.

The Loss of Ore or Concentrates in shipment on railroad cars can be reduced by putting a thick layer of straw in the bottom of the car before introducing the concentrate. The subsequent weight of the concentrate compresses the straw into a mat through which little material escapes.

*Associate professor of mining, University of California, Berkeley.

Surface-Plant Illumination

With the approach of winter the proper illumination of mills, smelteries and surface plants becomes of increasing importance from a safety and efficiency standpoint. Different authorities estimate that from 10 to 25% of all industrial accidents are caused, at least indirectly, by the lack of proper illumination; but generally the other circumstances connected with the occurrence of such accidents tend to obscure recognition of this cause, says an editorial in *The Anode* for September, 1916. For instance, a man is found at night injured through having been caught in belts or gears; the immediate necessity is to see that he is properly cared for, and full investigation of the accident may not take place until the next day. When this occurs, the lighting conditions will naturally not be the same as when the accident happened, and the fact that the man was not able to see what he was doing because of a shadow cast by a post or some piece of machinery will not be evident; indeed, the injured man himself may never have recognized the circumstance.

All working places should be properly lighted, but in many cases it would seem that men go on working under poor lighting conditions because they fail to recognize the difficulty under which they are laboring and the possibility of improving them. The following more common instances of poor lighting are therefore cited in the hope that foremen and men will recognize such defects where they exist, and have them improved.

Everyone is aware of the difficulty of seeing when passing from a brilliantly lighted place into one that is comparatively dark, but a similar condition on a poorly lighted stairway leading from a well-lighted platform often escapes the attention it should be given. Where such dark places exist under daylight conditions, a coating of whitewash on the walls or framing will often do much to lighten up the surroundings and make it possible for a man to see things that otherwise he could not. Entrances to buildings or tunnels under flues and dust chambers, particularly where tracks are in use, are instances of places where good light is greatly needed.

Most places that are used by numbers of men are well lighted, but those that are less frequently visited, such as those into which an oiler has to go, are generally not so well lighted, and yet these are just the places where the most serious accidents occur. The necessity for plenty of light on the operating floor of a large department is always apparent, but the need for the same amount of light under roasting furnaces, or in similar places where gears are situated, is not so well recognized, although the necessity is the same in both places.

In the lighting of machines or places where men have to go to operate apparatus, reliance is often placed upon a strong light coming from one direction only. This serves to throw one side of the machine into strong relief, but leaves the other in a dark shadow, and it may be that the side so shadowed should be just as well lighted

as the other. In such cases the operator coming from the well-lighted side into the shadow may be so affected by the stronger light that he is unable to see clearly and may make some mistake in his work. To rectify both the casting of strong shadows and the trying glare of unduly strong light, the light should be diffused, as much as possible, from a number of lamps well distributed.

In the plants, yards and around tracks, deep shadows at nighttime are a constant source of danger. Obstacles, holes or depressions in the ground, which ordinarily would cause little risk of accident, when hidden by shadows cause men to stumble and fall. Insufficient light or shadows around tracks may make conditions obscure to the drivers of locomotives on the industrial haulage system and cause accidents.

Dust and fume, settling on lamp globes, will often accumulate to such an extent that the light of the lamp becomes quite dim and ineffective, yet nobody takes the trouble to remove it until some other adjustment to the lamp is needed, and then perhaps some of the accumulation is shaken off.

Removing lamps from one place for use in another is a practice that all should discontinue and discourage. There are always supplies of new lamps available, and the only reason why any man should remove a lamp bulb, already in use in one socket to replace one that may have been burned out in another place is that he is too lazy to ask for it. The absence of a light to which he has been accustomed may easily be the cause of an accident to any man, and recognition of the fact should be sufficient reason to all men not to remove lights.

Flotation at Morenci*

At the time of remodeling and enlarging the No. 6 concentration plant of the Arizona Copper Co. at Morenci, the work was in progress nearly a year before the Inspiration experiments with flotation.

Meanwhile the Inspiration experiments started with semi-mysterious compounds and continued with simple reagents. A drum of cresylic acid and some pine oil were obtained for Morenci tests and a small can of cresylic acid was arranged so as to drip into the tailings where the latter plunged into the creek bed. A black mineral froth formed, persisting for several yards; and at the next plunge it became white again. Investigation showed that the instant dropping of the mineral was due to a town sewer which discharged into the creek.

By adding cresylic acid to the feed of a regrinding Hardinge mill, a rough froth concentrate was obtained, assaying over 45% copper, in which chalcocite and bornite predominated.

A small mechanical-agitation frothing machine was installed and with a feed of colloid separator fines it gave an extraction of more than 79% of the total copper and more than 92% of the available sulphide copper. Later, a Flinn-Towne pneumatic flotation unit was removed from Cananea and installed at Morenci and experiments demonstrated clearly that the flotation process would be suited to the recovery of slimed copper sulphides in the Morenci ores. A tube-grate cell was tested with such success that a large three-stage machine with a capacity of 400 tons per day, called the "C—B" machine, was designed and made. Operating during the month of April, 1915, with an average daily tonnage of 209, and working under the handicap of partially clogged tubes, blower troubles, etc., the average recovery of sulphide copper was 65% and it was proved that the copper in the mill tailing could be reduced to 0.5% or less, of which 0.25 to 0.30% was oxidized and beyond reach of flotation.

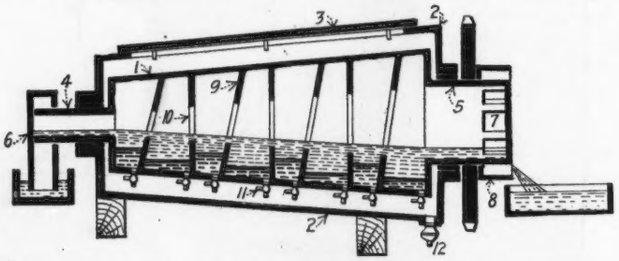
*Abstract of paper presented by David Cole, Arizona meeting, A. I. M. E., September, 1916.

Robbins Barrel Amalgamator

Experience with a straight-barrel amalgamator having demonstrated that efficient work was impeded by the collection of a layer of heavy concentrates upon the mercury surface, the present invention was designed to overcome this trouble. The apparatus is intended to bring pulped gold ores into intimate contact with mercury, so as to extract the gold in the form of amalgam, and to possess great capacity while requiring little attention.

The tapered barrel 1, shown in the accompanying illustration, is inclosed in the outer casing 2, which is provided with a removable door 3 suitably fastened to it. The barrel rotates on its inlet and outlet tubes, 4 and 5 respectively. To inlet tube 4 is attached the rotary scoop 6, common in most forms of tube mills. The outer end of the outlet tube 5 is closed, and the discharge flow is allowed by apertures 7 around the circumference of the tube. These apertures are protected by the guard ring 8, properly spaced from the apertures to allow a free discharge, the purpose of this arrangement being to prevent theft of amalgam.

The interior of the barrel is divided by a series of partitions 9 to form a number of sections or ungulæ, these partitions being set alternately at right angles to the barrel axle and inclined to it as shown. Openings 10 in the partitions constitute the inlet and outlet of each section in the series extending the length of the barrel. Referring to the illustration, it will be noticed that the volume of any given section is greater on one side of the barrel axis than on the other. It is therefore obvious that with a given volume of mercury in any section the surface of the mercury will rise and fall considerably as the barrel rotates.



ROBBINS BARREL AMALGAMATOR

This variation of level results in a more perfect settling of gold, whereas the alternate expansion and contraction of the width of mercury line in the section exerts a sort of kneading action on the layer of heavy concentrates above the mercury. Eventually this action brushes the concentrates through the discharge orifices 10 into the next chamber of the series as the mercury level rises. Discharge of the mercury for recovery of the gold is effected by opening the drainage cocks 11 and 12.

This apparatus is the invention of Percy A. Robbins, of Timmins, Ont., to whom a U. S. patent, No. 1,190,012, was granted on July 4, 1916.

Company Reports

The Ducktown Sulphur, Copper and Iron Co. Ltd., Ducktown, Tenn., reports for the year ended Dec. 31, 1915, a mining profit of £68,884 and a net after London expenses of £59,235. No statistics of production are given.

Carn Brea and Tincroft Mines in Carn Brea, Cornwall, reports for the half-year ended June 30, 1916, receipts of $196,320, total working costs of $171,796 and royalties of $6,585, leaving a net profit of $17,939. During the period 32,016 tons was crushed, from which an average of 21.22 lb. black tin was obtained. The cost per ton of ore treated was $5. A total of 1,122 ft. of development was performed, distributed as follows: Raising, 251 ft.; winzing, 148 ft.; crosscutting, 10 ft.; driving on lode, 713 ft. Development work has reached a depth of 1,250 ft., at which depth 443 ft. of lateral development has been performed. In the stopes the vein width varies from 6 to 12 ft. and the values run from 17 to 40 lb. tin per ton. Duing the period 98 men, boys and girls were employed on the surface, 240 for dressing and 246 men and boys underground, making a total of 584 on the payroll. Sixty-four are on leave, serving in the British forces.

Beaver Consolidated Mines official report for the quarter ended Aug. 31 summarizes progress as follows: Mine development aggregated 1,617 lin.ft. with a station cut at the 1,600-ft. level. Stoping operations excavated 2,077 cu.yd. Experiments with oil-flotation have not yet demonstrated the advisability of installing a flotation plant. A total of 313,905.73 oz. silver is in storage or transit. Cash on hand totals $43,-020.57.

At Kirkland Lake the 360-acre property held under option from the Kirkland Lake Gold Mining Co. is being developed with encouraging results. The shaft on the McKane claim has reached a depth of 288 ft. On the 100-ft. level a 4-ft. vein drifted upon for 191 ft. gave average assays of $15 per ton. Prospecting results proving unsatisfactory on the 200 level, the drifts were started on the 288 level. A 5-ft. vein was thus encountered 19 ft. south of the shaft, from which channel assays averaged $11 per ton. Continuation of the crosscut developed 10 ft. of porphyry averaging $7 per ton and encountered another vein, paralleling the first, this second vein being 12 ft. wide, from which channel assays averaged $12.80 per ton. This is an important discovery, and the shaft will therefore be extended to the 400-ft. level and prospecting continued.

Wolverine Mining Co. reports for the year ended June 30, 1916, a production of 6,641,492 lb. of copper, as compared with 3,435,459 lb. for the previous year. The price received was 20.62c. per lb., compared with 14.09c., a total of $1,369,285 compared with $484,061. All operating expenses were $626,459 and $7,609 was spent for construction, leaving a net profit of $735,-218. Dividends for the period to the amount of $660,000 were paid, as compared with $360,000 for the previous fiscal year. Rock hoisted was 391,898 tons; stamped, 388,898. The yield of the rock was 17.07 lb. per ton, and the cost per ton of ore milled was $1.39. The cost of refined copper was 8.11c., while the smelting, marketing and office expenses cost 9.43c. Drifting, sinking, crosscutting and raising amounted to 3,105 ft., compared with 625 ft. in 1914-15. Tonnage production was increased 108% over the previous year with a reduction in cost of 26%. This speaks well for the flexibility of the plant and the ability of the organization. Since its opening in 1891, the mine has produced 151,303,110 lb. of copper, and it is estimated by the management that there are still 12 years of life before the reserves within the property lines are exhausted. It will be necessary, however, to consider the question of a change in the method of sand disposal in the near future.

Poderosa Mining Co., Ltd., operating in Chile, reports for the year ended Dec. 31, 1915, net receipts from sales of ore, interest and transfer fees of £60,033, from which mining and general expenses in Chile, London office expenses and income tax of £38,445 were paid. From the balance depreciation of £4,211 and mine development expenses of £352 have been allocated leaving a net surplus for the year of £17,026, and reducing the balance to date to the debit of revenue account to £3,279. During the year 3,734 tons of copper ore, of an average assay of 21.86% copper and 5.93 oz. of silver, have been shipped to the smelters, as compared with 5,289 tons, assaying 18.23% copper and 3.95 oz. of silver in 1914. The mines have been pretty well stripped of high-grade ore to give the year's output of 4,392 ton of ore, and the continuance of even a moderate output is dependent on new discoveries. There may be 5,000 tons of 8% ore in the 6 and 7 south levels and the dumps probably contain 138,600 tons carrying 5,000 tons of fine copper, about one-half of which is recoverable by water concentration. A concentration plant has been in operation since April, 1915, treating 1,904 tons of mine ore and 2,573 tons of dump ore with an extraction of 58%.

The Mount Morgan Gold Mining Co., Mount Morgan, Queensland, Australia, for the half-year ended May 28, 1916, reports that revenue from all sources amounted to $6,146,889. Expenses charged off were $4,753,132, thereby leaving a balance of $1,393,757, of which $1,215,000 was paid in dividends. All ore treated amounted to 156,059 tons, yielding 8,307 tons of copper and 120,131 oz. of gold. Of this ore, 413 tons were miscellaneous ores. The mines produced 427,057 tons of ore. Ore reserves are estimated to contain 951,400 tons of high-grade, 2,827,700 tons of medium-grade ore, 360,300 tons of low grade and 129,200 tons of basic—a total of 4,268,600 tons. Development work totaled 1,808 ft. and consisted of 1,002 ft. of drifts, 105 ft. of recessing, 583 ft. of sinking and 118 ft. of raising.

The rotary roasters have been put into commission with satisfying operation. The sintering of flotation concentrates which has been a source of trouble on account of their fineness has been overcome. The following table gives details of concentration results:

	Weight tons	Assays copper, %	Assays gold dwt.	Recovery copper, %	Recovery gold %
Ore treated	72,074	2.17	4.99	...	...
Table concentrates produced	17,281	2.88	8.76	31.86	42.07
Flotation concentrates produced	4,790	19.22	27.34	58.86	36.40
Total concentrates produced	22,071	6.43	12.79	90.72	78.47

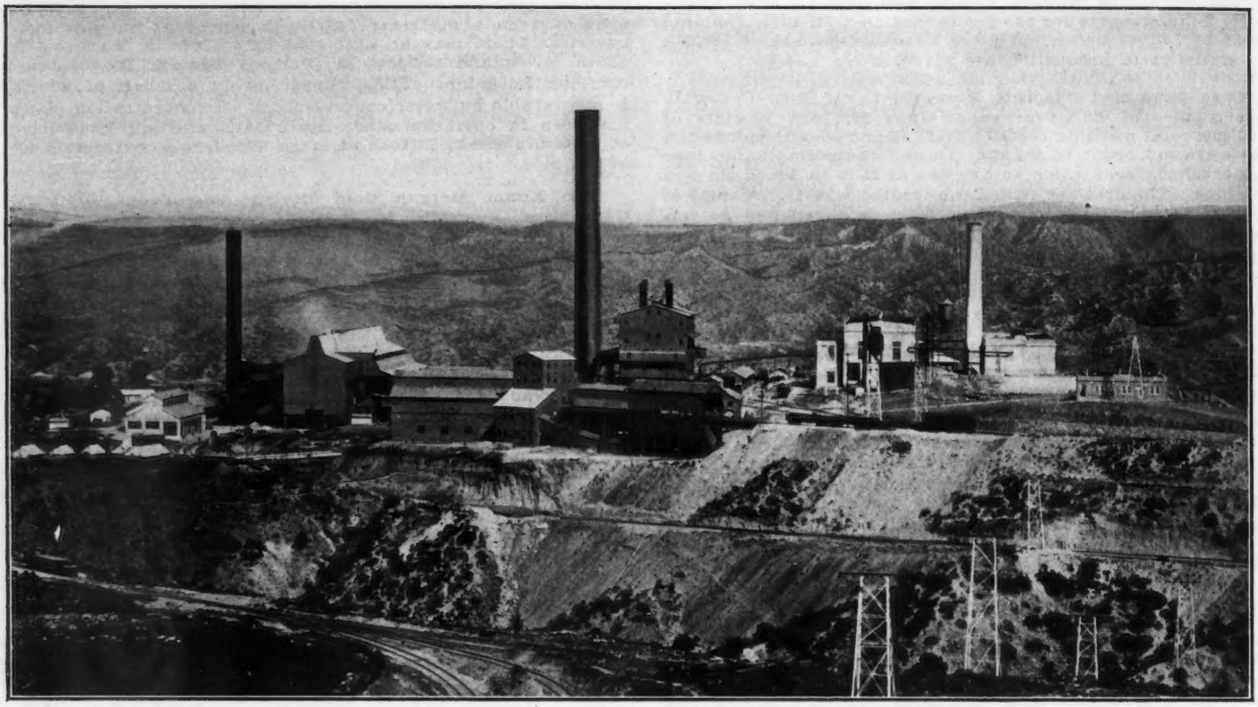
The working cost of Mount Morgan ore treated, inclusive of development and estimated realization charges, amounted to $11.65 per ton.

Broken Hill South Silver Mining Co., Broken Hill, N. S. W., Australia, report for the half-year ended June 30, 1916, shows a balance from the working account of $585,581 and receipts of $1,682,018. After providing for all other charges and income, the net balance for the year was $1,096,437. The mine produced 92,553 tons of ore averaging 14.5% Pb, 6.8 oz. Ag and 13.4% Zn. Of this ore 95.9% was mined on contract, 0.8% by miners on wages and 3.3% from development work. The average earnings of contract miners were $4.18 per 8-hr. shift and of truckers $3.47 per shift. There were 400 surface employees of whom 381 were in daily attendance, and 857 underground employees of whom 757 were in daily attendance. All employees totaled 1,257 and averaged 1,138 in daily attendance. There was 34,797 cu.yd. of loose material sent below to fill stopes at a cost of 86c. per ton of material used for filling, or 32c. per ton of ore extracted. The following gives a tabulation of the classification effected by the concentrating plant:

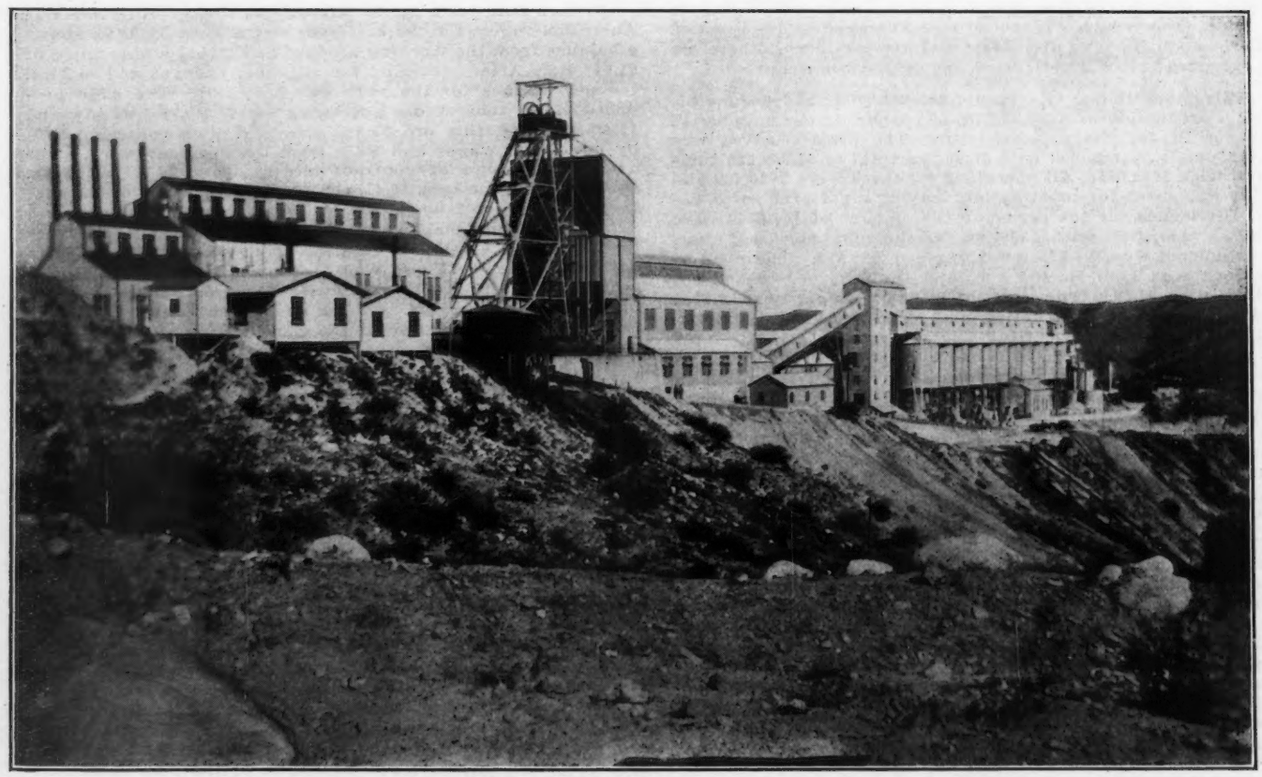
	Net Weight, Tons	Proportion	Assay, % Pb	Assay, Value, oz. Ag	% Zn	Proportion of Metal Contents % Pb	% Ag	% Zn
Concentrates	16,985	18.6	59.8	21.2	9.6	76.6	57.5	13.2
Tailings:								
Zinc	51,157	55.9	3.1	3.0	16.3	11.9	24.6	67.7
Quartz	9,618	10.5	1.4	1.6	5.8	1.0	2.4	4.5
Slimes	13,770	15.0	10.2	7.0	13.0	10.5	15.5	14.6
Total ore	91,530	100.0	14.5	6.8	13.4	100.0	100.0	100.0

Working costs amounted to $6.38 per ton and consisted of $4.14 for mining, 31c. for filling stopes, 70c. for development and $1.23 for concentrating. Total mine cost per ton of concentrates was $34.42. In treating this ore 19,834,100 gal. of water was consumed. Owing to the refusal of a section of the underground employees to carry out the arrangements made in the compulsory conferences, a strike occurred in January and February, entailing a complete cessation of production for nine weeks and four days. As a result of the strike the working week was reduced to 44 hours instead of 48. This caused, through wage increases and reduction of time, an additional expense of $224,532 per year.

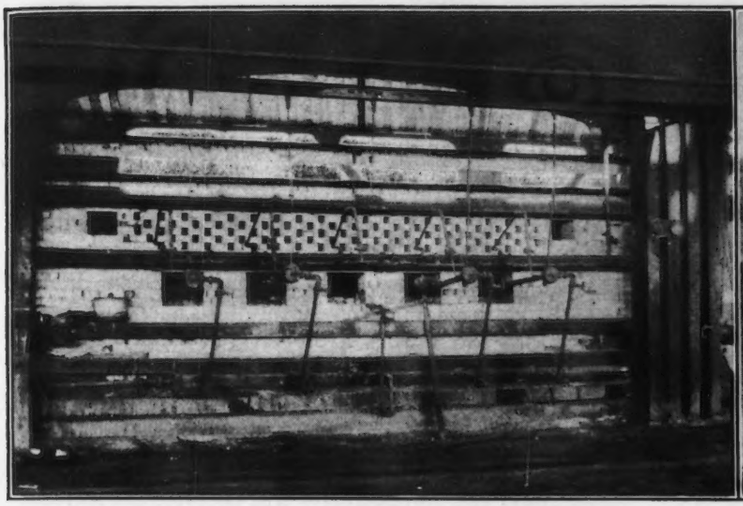
Photographs from the Field



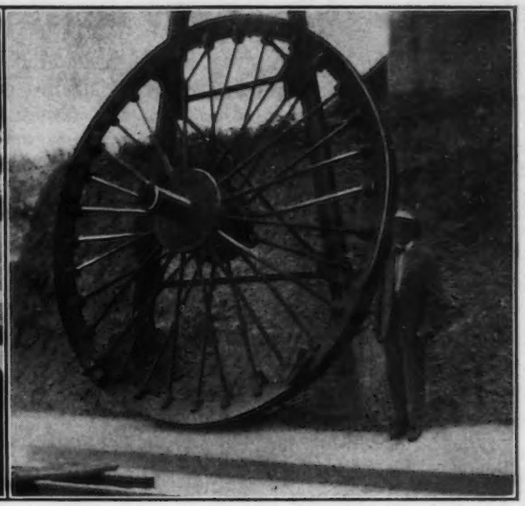
PLANT OF THE INTERNATIONAL SMELTING CO. AT MIAMI, ARIZ.



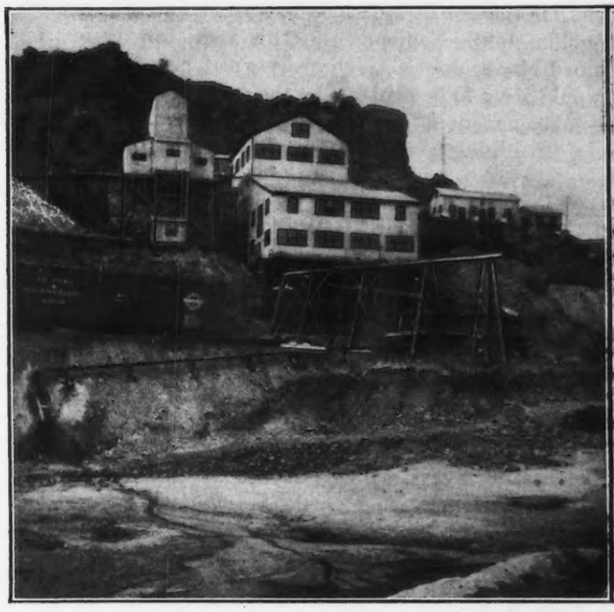
MIAMI COPPER CO.'S HEADFRAME—MILL AND CONCENTRATE BINS IN BACKGROUND



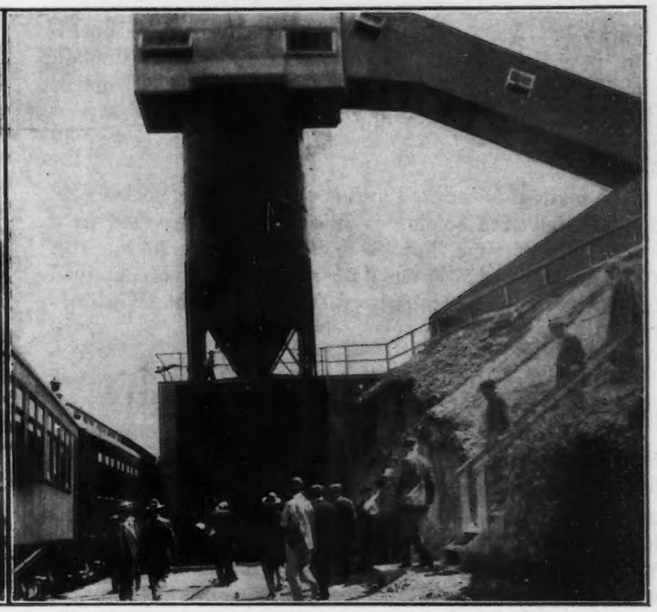
END OF OIL-FIRED REVERBERATORY AT DOUGLAS



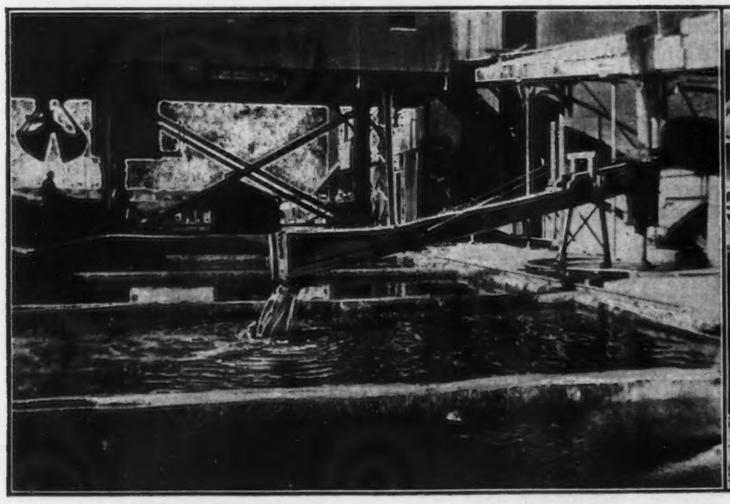
AN INSPIRATION HOISTING SHEAVE



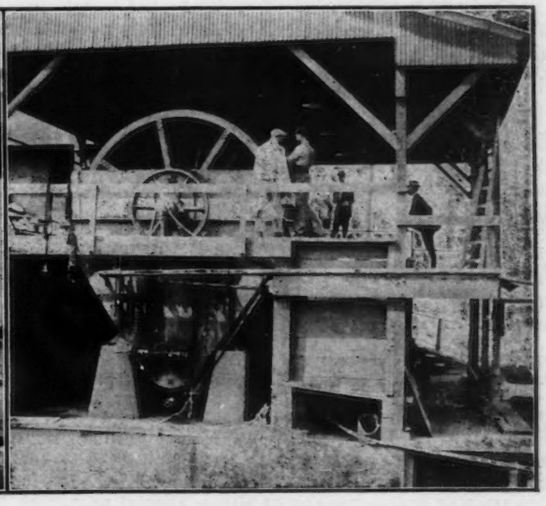
C. Q. EXPERIMENTAL MILL AT LOWELL



LOADING BIN FOR INSPIRATION CONCENTRATES



DISCHARGE LAUNDER AND DISTRIBUTOR AT CHINO MILL



OLIVER FILTER AT OLD DOMINION MILL

Rescue Operations in Mines*

The Bureau of Mines has just issued, in handbook form, a pamphlet that is the result of serious studies covering a period of considerable time on what the bureau believes to be the best method in rescue and recovery operations in both coal and metal mines after fires and explosions. It outlines a method of procedure for the operators and miners to follow in such emergencies and explains just what part the Bureau of Mines is expected to take in such work.

The bureau has no authority to enforce any of its recommendations or to enforce any provision of state laws. After a mine disaster is investigated by the bureau, a report is prepared. If the operator desires, a copy of the report is furnished for his confidential information. As a rule, the recommendations of the bureau have been followed.

The manual does not preach on what might have been, nor does it advise a policy of observant hesitation; but it gets right down to business on the assumption that some men still live and can be reached by systematic effort and teamwork. The first part of the book deals with operations in coal mines and the second part with operations in metal mines. In each case a summary is given of some of the things to do. An important item is: *"Place experienced men to guard all entrances and keep a record of all happenings."*

The manual is indexed and is of convenient pocket size. The limited free edition is likely to be exhausted in a brief space of time, but the book is well worth the 10c. (25c. bound in stiff covers) for which it may be obtained from the Superintendent of Documents at Washington, D. C.

*United States Bureau of Mines, special pamphlet, "Rescue and Recovery Operations in Mines after Fires and Explosions," by James W. Paul and H. M. Wolfiin, August, 1916.

Alaska Gold Mines Co.

The *Boston News Bureau* reports that it seems to be the settled conviction of those closest to the Alaska Gold Mines Co. management that for at least several months nothing need be expected in the way of operating returns better than those now being reported. During the first 10 days of September the average assay value of the ore was $1.51 per ton, but for the entire month the average dropped to $1.30 per ton, indicating rather poor results for the last 20 days.

There is a large accumulation of low-grade ore broken down in the upper-level stopes, and this material must be got out of the way and milled—as there is a small profit in the operation—before opportunity is given for opening up stopes in the lower levels in a manner which it is believed will yield a larger return per ton of ore handled.

Officials of the company are convinced that the original scheme of opening up the stopes was a mistake, in that it resulted in an excessive caving of the hanging-wall material, which was low in grade; but as there is over 2,000,000 tons of this low-grade ore already broken down in the upper levels, quite a period must elapse before any new scheme of mining can be put into effect. The new plan of mining will probably involve an additional cost of 5c. per ton.

Present indications are that the mine will never be able to produce the expected tonnage of ore that will grade up to $1.75 per ton, so that early estimates as to prospective profits must be revised downward.

Hayden, Stone & Co., in their own circular letter say that "Alaska, in September, milled 135,760 tons; the heads ran $1.30 per ton. The grade of the ore, while somewhat less than in the previous month, was above the average of the year, as a whole. The tonnage was less than in previous months, due, as Manager Thane explains, to exceedingly heavy storms during the middle of the month, which resulted in such enormous flows of water that haulage was interfered with until drainage ditches could be enlarged to take care of the same.

"The progress at such a property as the Alaska Gold Mines is bound to be interrupted from time to time by events that cannot be foreseen, so that, followed from month to month, there seems at times to be comparatively little gain. The property has now, however, reached the point where a little broader range can be taken, and viewed from this standpoint, it will be seen that material progress has been made.

"In September of a year ago, Alaska treated 131,862 tons, but the ore in that month carried but 89c. per ton in gold. While September of this year, for reasons explained above, does not show any great gain in tonnage, it would seem to be evident, by the gain in the value, that the management is gradually acquiring satisfactory control over mining conditions."

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

of Engineering and Mining Journal, published weekly at New York, N. Y., for October 1, 1916.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Chester W. Dibble, who, having been duly sworn according to law, deposes and says that he is the Vice-President of Hill Publishing Co., Publishers of Engineering and Mining Journal, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business manager are:

Publisher, Hill Publishing Company, 10th Ave. at 36th St., New York, N. Y.

Editor, Walter Renton Ingalls, 10th Ave. at 36th St., New York, N. Y.

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CHESTER W. DIBBLE,
Vice-President, Hill Publishing Co.

Sworn to and subscribed before me, this 29th day of September, 1916.

[Seal.] RICHARD L. MURPHY.
(My commission expires March 30, 1917.)

Correspondence and Discussion

Some Practical Notes on Mine Surveying

I have read with keen interest and appreciation, W. F. Boericke's article in the *Journal* of Aug. 19, 1916, which is indeed practical in every respect. I do not wish to criticize his article in any way, but I would like to put before his consideration the use of the plane table in stope mapping.

I have been mine surveyor on one of the largest gold-copper mines of Chosen, and on all occasions of stope mapping I have used the plane table, perhaps sometimes in conjunction with a prismatic compass. The ore deposits were exceedingly irregular, being of the contact metamorphic type; the stopes therefore were similarly irregular. Two Orientals were my assistants, and occasionally I would select an Oriental miner to assist.

The table that I used was approximately 18 in. square, provided with the simpler form of alidade and a compass. I took with me underground a 2H pencil, scale and eraser. Pinned to the table with thumb-tacks was a sheet of cross-section paper (a square inch divided into hundredths). Stationed at the table with one assistant, it was a quick and satisfactory process to sight with the simple alidade to a candle which was held by the other assistant, who also held the zero end of the steel tape (a "metallic" tape would have served just as well). As each sight was taken and the line made on the paper, the assistant with me read off the lengths. The table station was marked on the paper by an ordinary pin firmly planted into the table. The result was that I had my stope already plotted, in plan, when I came to surface. Tracings of the larger-scale mine plans were then laid over this stope map, and the stope's relation to the workings both above and below was readily seen. I usually worked, for these particular stope maps, on a scale of 1 in. = 20 ft.

If I had difficulty in tying the stope in to the mine map, a quick traverse with the prismatic compass would be satisfactory, the notes of the compass traverse being "booked" on the table. When the stope was long and direct sights all around its periphery obscured by pillars, a plane-table travese was made in a similar way to the table's use on the surface.

I found that these stope maps tied in remarkably well with the general working plans and were in many cases very useful to the mine superintendent when he wished to "spot" a chute raise from the level below or a winze from the level above.

There are two disadvantages, in my opinion, with respect to the use of a plane table underground: (1) The table is a bit clumsy, even when it is dismantled from the tripod; (2) any steep sights that are encountered both above and below the horizontal demand either a clinometer or very good judgment to convert the slope distance to the true plan length. I obtained a fairly good idea of what to subtract from the stope distance to bring it to the true horizontal or plan length, but when it was considered that the vertical angle was between 20° and 30°, I measured it with the compass, which had a clinometer attachment.

The plane table can thus be used to great advantage by the sampler or in conjunction with him, the numbers of his samples being marked in their correct position on the plane table plan. He has then only to make a note of the width and any other remarks that are necessary, and need not make a lengthy description or perhaps a crude sketch in his notebook, showing the position of each sample. For a flat deposit, such as Mr. Boericke mentions, I should imagine the plane table would be particularly applicable.

It will be found necessary to have a waterproof covering, so that when the table is to be carried through wet parts of the mine, the paper is not ruined. Incidentally this may be cited as another disadvantage of using the plane table underground—the impossibility of working in wet stopes—but there is usually a dry spot that is advantageous for working purposes. I am interested to know whether this method of stope surveying is extensively used by mine surveyors.

A. ALEC JONES.

London, E. C., Sept. 7, 1916.

Carranza's Latest Mining Decree

I take the liberty to inclose a translation of the mining law of Sept. 14, 1916, decreed by Gen. Venustiano Carranza, First Chief of the Constitutionalist Army of Mexico.

The preamble to the decree, as you will see, states that the important mining properties in Mexico are held by foreign capitalists, who gamble with their mining stocks and will not work, notwithstanding that the foreign interests in Mexico run no danger and are being effectually protected; that either the number of workmen which the government will designate and which will depend on the size of the mining fields will have to be given employment, or that the properties will be confiscated.

The investment of capital in years past made it necessary to secure large mining fields. The abnormally heavy taxing of the products and of the mining fields is a direct attack on the foreign capital invested in mines in Mexico. The new decree is practically a forfeiture, as under present circumstances it is impossible to reduce these fields in size, as this would require careful and tedious examinations and surveys.

In many of the mining districts in Mexico it is at present absolutely impossible to carry on mining operations, or even to visit the mines. In fact our Government in Washington tells us emphatically to stay out of Mexico, and recent events prove that there are founded reasons for that advice.

The *Engineering and Mining Journal* is widely read in Mexico, and its views and opinions have weight there. Will it not favor us who have interests in Mexico by making it plain to the de facto government of that

country that the regulations of the decree cannot be complied with; that most of the stock of American companies owning mining property in Mexico is not held by capitalists; that the conditions in the mining regions of Mexico generally are not what Mr. Carranza states and may think that they are; that foreign operators would certainly work if they could, but that in most cases every attempt to do so has resulted in the loss of mining material, of products and of supplies, and that neither now nor for probably a long time will owners be able to realize on any stock they may hold? B. W.

New York, Oct. 2, 1916.

Mining Law of Sept. 14, 1916 from "El Pueblo", Mexico City, Sept. 16, 1916. All concessions of mines in the republic are required to work their grants. Pertenencias will be declared void if work is stopped for two uninterrupted months or for three interrupted months during the year.

I, Venustiano Carranza, First Chief of the Constitutionalist Army, in charge of the Executive Power of the Republic, exercising the faculties with which I am invested, considering:

That it is a principle of public right, not only admitted by authors of treaties, but also the common and constant practice of the most advanced nations, that the state shall intervene and exercise the proper functions of its institution when the established interests of the individual, of the nation or of humanity so exact, either to safeguard or to procure his progressive development, and that it shall give both matters most careful examination in order to make legitimate and to regulate accordingly the march of government.

That the intervention of the state when the established interests of associates are in danger shall be in proportion to the requirements of their importance, according to the nature of these interests and the special circumstances of time and place, in order that it may be opportune and appropriate; and that therefore it should cover the ground when individual and corporate activity is unable to reach the proposed end, and in such a manner that the state may not intervene when only individual interests are concerned which do not affect any general interest.

That in the mining laws of Mexico which were in force before the present law and before the one which preceded it, the working of mines was considered a public benefit, in accord with the principle above mentioned, and mines were granted on condition, which had to be fulfilled, that a certain number of workmen had to be maintained in the small number of pertenencias (or units of mining field) which were given in each grant, so that the work would not be suspended longer than a certain time; making this benefit consist in that for the good of the nation all the metalliferous veins had to be worked and in the advantages which such work would bring to the public exchequer, it being considered unsuitable for the development of the mining industry and therefore for the general industry of the country that this branch of the national wealth be subject exclusively to the will of the concessionaries, who could in such a case paralyze it at will.

That the mining law now in force, reserving to the nation the ownership of the mines, in granting right of possession to private parties or corporations, thought it well, however, to subject them only to the payment of a tax, leaving to the individual initiative of the concessionaires the working of the same, so that it was left to their decision whether the mines would be worked or would indefinitely be left dormant.

That this law, which not only had for result that it favored only the large speculations, made impossible the working of the mines by miners without capital and concentrated all important business in the hands of foreign capitalists, who mostly instead of doing useful work, limit themselves to gambling on the stock exchange, has occasioned the grave inconvenience that large extensions of mining fields and metalliferous veins can under cover of this law be withdrawn from a development fruitful to public interest.

That over and above these evils, the greater part of the mining concessions have occasioned another of grave penetration under the circumstances through which the republic is passing on account of the strife which the Constitutionalist government has had to sustain first against the usurpation of Huerta and later against the reaction which brought about the division of the triumphant army; namely, the evil which consits in the stopping of the work in the mines; in this manner leaving without means of subsistence the greater part of the mining population and depriving the exchequer of the resources which this industry ordinarily produced.

That the manner of proceeding of the greater part of the mining operators which has been referred to is in the present case so much more dangerous as it helps the movement to increase the obstacles which this government has to overcome in order to bring order and insure peace because they hereby help its enemies to continue the unpatriotic work of seeking help from foreign governments, inciting them to intervene in matters pertaining to the country, under the pretext of saving foreign interests, interests which run no danger and which this government has been and is abundantly disposed to protect effectually and to give whatever guaranties they can rationally exact.

That in view of what has been above stated it is necessary to remedy seasonably the indicated evils and to do so to take the steps which the public interests demands, as a painful experience has shown in an unmistakable manner that if individual action is left in this case to its own free initiative it severely injures the vested interests of the country.

Therefore, I have thought well to decree, as follows:

Art. 1. All mine concessionaires are obliged to work their mines or will be liable to forfeiture if their workings are idle for more than two continuous months or for three interrupted months during the year.

Art. 2. The mine concessionaires who have a just cause to stop work, have to get from the Department of Fomento the corresponding permit, which will only be granted if the cause is well proven and for a time which in no case will exceed three months, unless after this time is past the cause remains and makes work completely impossible, because in that case the time will be prolonged for the strictly necessary time.

Art. 3. The Department of Fomento, listening to the interested parties, will determine in each case that new concessions are given or in those which already have been given and which have not been worked, the number of workmen, which as a minimum must be employed by each mining concessionaire in his workings, taking into account the number of pertenencias of each concession.

Art. 4. The concessionaires who have been or are working their mines must employ in their work as many workmen as they have been using or were using at the time that work was stopped; without prejudice (without refusal) by the Department of Fomento, to hear the said concessionaires and to change this number according to the necessities of the work mentioned.

Art. 5. The forfeiture of a mining grant having been declared by the Department of Fomento, the fact shall be immediately made known to the Department of Finance, so that it may be resolved whether the mine referred to shall be declared open to new denouncement by the public, or whether it shall be worked for account of the nation, in which case someone will be named to administrate the mine and to continue the respective work.

Art. 6. This law will be in force from the date of its publication.

Constitution and Reform. Given in the City of Mexico in the National Palace, on the 14th day of September, Nineteen Hundred and Sixteen.

(Signed) V. CARRANZA.

Flotation at Santa Gertrudis

In an editorial in the *Journal* of Sept. 23 you refer to the success of flotation on silver ore at the above mine under the heading of "Cyanidation of Flotation Concentrates."

As a matter of fact, concentration of the ore by flotation was not nearly so successful as the treatment of the concentrate by cyanide. Most of the "ore" is old oxidized stope filling assaying about 10 oz. silver per ton, from which, by straight cyanidation, a recovery of about 90% is made, as mentioned in the recent paper by Hugh Rose, published in the *Bulletin* of the American Institute of Mining Engineers.

In cyaniding the flotation concentrates in the laboratory, a recovery of 98% was obtained without roasting or otherwise removing the oil. To test the theory that oil consumes cyanide, various mixtures of oils were agitated for 72 hr. in cyanide solution, and we found there was no consumption of cyanide due to the oils. It is obvious that when one has to treat both concentrates and tailings by cyanide, nothing is gained by concentrating.

However, as you say, there are probably silver ores, especially those containing base metals, to which flotation can be successfully applied in districts not too remote from a smelter, provided the smelter is running and there are freight trains also running, a condition not likely to prevail in Mexico soon. As an instance of suitable ores I might refer to those of El Tigre mine in Sonora and the Real del Monte at Pachuca. W. MOTHERWELL.

Salt Lake City, Sept. 29, 1916.

Dust Losses in Copper Smelting

On page 396 of the *Journal* of Aug. 26, there is an interesting article by Dr. L. D. Ricketts, on "Dust Losses in Copper Smelting," in which we note that mention is made of the use of ten General Electric transformers for 50,000, 75,000 and 100,000 volts.

We take the liberty of calling your attention to the fact that the transformers used in this installation were manufactured by the Westinghouse Electric and Manufacturing Co., and we would appreciate it if you would make a correction to this effect, as we believe you desire to be accurate in statements of this kind. M. C. TURPIN.

East Pittsburgh, Penn., Sept. 20, 1916.

Revision of the Mining Law

The Mining and Metallurgical Society of America has instituted a referendum among its own members, and also among all the other mining societies, associations, etc., of the United States—both national and local—upon the following questionnaire:

1. Shall it be aimed to preserve to the maximum possible extent the phraseology of our present mining law and its principles of administration, thus retaining the benefit of some of the wealth of legal definitions that have been rendered at great cost?

2. Shall the new mining law be made to cover all classes of valuable mineral deposits other than coal, and shall that intention be defined so clearly that there will be no misunderstanding of it?

3. Shall actual discovery of a valuable mineral deposit be necessary to a valid location of a claim?

4. Or shall the new law authorize mineral locations without discovery in any part of the public lands officially classed as mineral; and mineral locations upon discovery in any part of the public lands whether officially classed as mineral or nonmineral?

5. Shall there further be a provision permitting bona fide prospecting on land classified as nonmineral and protecting the prospector in the meanwhile?

6. Shall Article 4, if adopted, be further limited so that patent may not be secured until a discovery has been made?

7. Or shall discovery or nondiscovery be immaterial in patenting?

8. Or shall there be required a considerably larger payment for land patented without discovery than with it?

9. If Article 6 be adopted, shall there be the proviso that only one discovery need be made for a group of contiguous claims of one ownership?

10. Shall mineral claims hereafter located be 660 ft. square; that is, 10 acres in size and square in form?

11. Or shall they be 1,320 ft. square; that is, 40 acres?

12. Or shall the claim unit be 660 ft. square, with the proviso that when four units be located in a square of 1,320 ft. sides only the exterior corners (or lines) need be staked?

13. When the proposed square claims are located on surveyed land, shall they be required to be sub-divisions of the surveyed sections?

14. If not located on surveyed land, shall it be required that the boundaries run north and south and east and west?

15. Shall the number of claims locatable by one person or association be limited or unlimited?

16. If limited, what shall be the limit?

17. Shall existing regulations concerning the marking, notice and record of location be continued?

18. Shall there be the requirement that within 90 days after the date of location, record thereof shall be made in the United States Land Office of the district?

19. Or shall the time allowed for recording be more or less than 90 days? If so, what?

20. Shall the annual assessment work be at the present rate, namely, $100 per 20-acre claim; that is, $5 per acre?

21. Shall it be provided that an equivalent sum of money may be paid into the United States Land Office in lieu of the performance of assessment work?

22. Or shall it be provided that an increased sum of money—say $7.50 per acre—may be paid into the United States Land Office in lieu of the performance of assessment work?

23. Shall a person or association holding a group of contiguous claims be permitted to do the assessment work upon one claim and thereby hold the group, the amount of such work to be equivalent to $5 per acre for each claim of the group?

24. Shall a person or association doing assessment work in any one year to the value of more than $50 per 10-acre claim be given credit for the excess in succeeding years, provided, however, that no fractions of $50 shall be considered for this purpose? (If the claim unit be 40 acres, these figures would be raised to $200.)

25. Shall there be emphatic provisions to insure the honest performance of annual assessment work?

26. Shall it be provided that in performing assessment work labor shall be reckoned at the current rate of wages for miners in the district? Or at some other rate; and if so, what?"

27. Shall it be required that every holder of a claim shall file annually a record of his assessment work, accompanied by vouchers, in the Land Office of the district?

28. Shall proceedings for patent remain as now?

29. Shall proceedings for patent remain as now with the proviso that only the exterior boundaries of a group of claims need be monumented?

30. Shall proceedings for patent remain as now with proviso that absence of records in the Land Office of conflicting locations shall be taken as prima facie evidence that none exist that are valid?

31. Article V of the memorandum adopted by the New York Section reads as follows:

Subject to the existing extralateral rights of mining claimants or patentees, the holder or patentee of a mining claim located hereafter to have the exclusive right of possession and enjoyment of the surface held by him and of the minerals under it, bounded by vertical planes passing through surface boundaries of said land, but not the right to follow any mineral deposit beyond said planes. And the holders or patentees of claims heretofore located to have similar exclusive possession of all the mineral in said claims that is not covered by any existing extralateral rights.

The above article abolishes extralateral right in so far as any claims hereafter to be located are concerned. The extralateral rights of existing claims may not be taken away, however, wherefore any new location and grant of patent may be made only with the reservation of such rights. The rights of existing claims having been thus expressly preserved, the last sentence of this article confers upon previously located claims the rights to everything comprised within the vertical projection downward of their side lines that is not legally claimed by anybody else, this being thus an addition to the original extralateral rights.

The above article has received general approval, with scarcely any criticism. The following question is therefore put directly to the membership.

Do you approve Article V of the New York memorandum, or not?

32. Shall it be provided that final entry and payment be made for such claims within seven years after date of location, exclusive of the time covered by pending adverse claims? Shall the time allowed for this purpose be more or less than seven years; if so what?

33. Shall the new law provide for appeals from decisions of the United States Land Office to a court of competent jurisdiction?

The Committee on Mining Law, to which the Council referred the memorandum adopted by the New York Section on Apr. 19, 1916, has not made any formal report as yet; but the following is summarized from communications received from the several members of the committee and is here published as being illuminating with respect to some of the matters that are included in the above questionnaire.

Excerpts From the Correspondence of the Committee

The identity of the authors of these communications being confidential, they are here indicated by letters rather than by names.

A. Since I am convinced of the vital importance of the mineral industry in our national affairs and believe that the day may come when this industry will show a declining tendency, and since I believe further that it has been and is a serious error in policy for our Government so to dispose of agricultural, ranching, town-site and desert lands, as to retain neither the title to the minerals beneath them nor the right to permit their exploration for minerals by any bona fide prospector, so now I am in favor of the adoption of a principle somewhat as follows (and this will be found entirely in accord with many former declarations of principle by Congress):

Title to ores and minerals beneath the surface shall be conveyed only by and under the laws relating to mines and minerals, and no other form of patent shall be construed to convey valuable minerals except sand, earth, clays and building stone, whether said land be at any time classified as mineral or nonmineral. Furthermore, while in every

case the surface proprietor should have the preference and certain privileges in connection with the location and operation of mines of whatever sort which may be contained in his land, yet he shall never have the right to obstruct the entry upon his premises and the operations of any prospector who desires to search for minerals, provided that said prospector by his operations shall not injure or destroy buildings, ditches, roads, etc., and must always compensate the surface proprietor for the value of land occupied and for damages to the surface, etc., all of which shall be subject to appraisal by appraisers appointed by the court.

I am very thoroughly convinced of the importance of this principle. When our public domain is exhausted, as it soon will be, there will no longer be ground for the prospector. He will be hounded from private territory as he is now practically from national forests. Unless he is given some open and recognized right of entry on privately owned land, mineral discoveries will in a few years or decades dwindle to the vanishing point.

I am not in favor of 10-acre unit claims, but do believe that in every district where the land has been subdivided by United States land surveys the unit should be any 40-acre tract or established lot or fraction indicated on the township plat and no other, that the number of claims located by a person or association in any one district should have some limit, and that final entry should be made within seven years.

Registration should be required in both the United States Land Office and the office of the county clerk and recorder, or else the Land Office should be required to file notice with the county clerk and recorder within 60 days.

I am sure that many of our members do not keep clearly in mind the difference between location of a claim for the purpose of prospecting it and final entry for the sake of acquiring a patent. That this is true is indicated by much of the discussion and by the further fact that while the memorandum of the New York Section as drawn provides for location without discovery on land that may be classified as mineral, it does not anywhere provide that a discovery is necessary before issuance of a patent. It certainly is not my idea to make it possible for anyone to get patent to a piece of land under the mining laws without actually finding ore, but I do believe that the prospector should have exclusive possession of his location while he is trying in good faith to make a discovery.

B. I am inclined to agree with the propositions to permit location without discovery upon any classified mineral land, and with discovery upon any land, but if these are adopted, would it be wise to allow payments to be made to the Land Office in lieu of the performance of assessment work?

It was my opinion at first that abuses of this privilege would surely occur. Locations for purposes other than mining would be made on land not classed as mineral and the locator might be very willing to hold the land at a cost of $5 per acre, paid to the Land Office, when he had no reason whatever for believing that it would ever produce mineral; but on the other hand the Government would be receiving a fair income from the land, and if the locator were compelled to make final entry within a fixed time, say seven years, and then only on affidavit in the present form, he would be unable to get good title through an evasion of the law. The present form in applying for patent reads as follows:

> That there is a true fissure vein, lode or ledge with well-defined walls carrying gouge, within said claim, having an average width of..... feet, running in a ..... and ..... and containing quartzose vein matter carrying iron and copper pyrites, and there is blocked out or in sight ..... tons of ore therein of an average value of ..... dollars per ton.
>
> That there has been a large amount of money expended on said ..... vein, lode or ledge, mining ground, claim and premises by said corporation, the applicant for patent herein, and by its grantors, to wit: ..... dollars in running a tunnel ..... feet long with drifts, crosscuts and stopes therefrom; and there has been extracted from said vein, lode or ledge more than, to wit: ..... tons of ore of the value of about ..... dollars per ton.—"Rickets on Mines," 1911, p. 393.

(By the way, I have had no experience in getting patents on "disseminated orebodies." How have the patentees got around the specification describing a "true fissure vein?")

We can imagine a case where a locator discovers valuable mineral on land that had not been classed as mineral, and for self-protection he would locate other claims on adjoining ground for a wagon road, rope tramway or other means of outlet to a railroad, wagon road or river, and with no indications that would lead him to explore the ground for mineral. With the privilege of paying $5 per acre to the Land Office, he would be able to head off adventurers who might try to harass him. The agents of the Forestry Service would doubtless oppose a plan that would permit such locations, and with reason, for this would allow locators to take up valuable timber land, with a view of realizing on the timber.

C. The only novel suggestions that I have to make are with respect to a number of claims locatable by one person, and proceedings for patenting. As to the former, the plan I suggest is similar to that sometimes adopted by foreign countries in the matter of concessions. They give a similar right to explore a large section of territory within a specified period, but require that a smaller section be finally selected and the remainder relinquished for the use of the Government or others. It strikes me that in view of the fact that in the future mining operations in this country will have to deal more largely with extensive low-grade deposits than with the small high-grade veins which are readily discoverable upon the surface, an opportunity should be given the locator of claims to include within his original locations sufficient territory to cover all of any given deposit which could be worked economically as a unit. It strikes me that two years would be sufficient time in which to determine what part of the original location could be advantageously worked in this manner, and that the remainder should then be thrown open to exploration by other parties. I have suggested 15 claims of 40 acres each, equal to 600 acres, which even for "porphyry coppers" ought to be large enough.

Two years will probably be sufficient, too, for the determination of the strike and dip of smaller veins, enabling one to learn what claims he should hold in order to protect his vein upon its dip.

With reference to patenting, inasmuch as the claims under the proposed new law would have no extralateral rights, it would be unnecessary to define accurately the lines of interior claims, but because the public-land surveys are usually inaccurate, it is desirable that the exterior boundaries should be accurately marked upon the ground. Second, it has been contended that claims should not pass to final entry without the discovery of mineral within their boundaries. The only reason that I can see for this requirement is to prevent the acquisition of land

under the mineral-land laws for purposes other than mining. On the other hand, there may be several strong geological reasons for the belief that valuable mineral deposits exist beneath the surface of a certain claim and yet, in the orderly working of the mine, it may not be convenient to actually expose such deposits within the seven-year limit.

I approve the recommendation of another member that hereafter grants of land under any law other than the mineral-land laws shall not convey title to valuable mineral deposits underlying such land; but that all public lands so granted hereafter shall be subject to exploration by citizens of the United States for the discovery of mineral deposits; that the owner of the surface have preference over others in such exploration; and that he shall be properly compensated for any injury that his land or improvements may sustain by reason of such exploration by others than himself.

I do not approve the suggestion that in lieu of annual assessment work an equivalent sum may be paid into the Land Office, but I believe the payment of a 50% greater sum should be allowed.

In patenting a group of contiguous claims no survey should be required except such as is necessary to mark exterior boundaries. Should no discovery of mineral have been made within the limits of a claim before final entry, the price charged for the land should be $100 instead of $5 per acre.

D. I believe in the separation of surface and mineral rights. It works well in Mexico.

I favor abolishment of the demand for a discovery, and I go further. A colleague says, "It . . . is not my idea to make it possible for anyone to get patent to a piece of land under the mining laws without actually finding ore." I want to enter the strongest kind of a plea against any such limitation. In patent proceedings the demand for a discovery has been the curse of camps like Bisbee. Under Secretary Fisher for a while it practically put a stop to patenting there. To permit locating without discovery would be to accord legal sanction to a practice that is all but universal in camps with blind surface. The trouble that has been caused by the discovery clause has chiefly been in patenting. If the distinction be drawn, permitting possessory title without discovery, but demanding it before title in fee can be granted, we had better let the law stand as it now is.

Consider a case: X is developing a group of 12 claims, three wide and four long, and gets ore in two claims at opposite corners of the group. He has not found ore in the other 10, but has hopes and spends some money every year in searching for it. He wants to patent in a group, but can only patent two because he cannot show valuable mineral on the rest. Seven years pass; he has found no mineral, but is still searching. It is now proposed to compel him to make entry in seven years. If he must first find mineral, he will lose his ground and see his two productive claims isolated and perhaps stranded high on a ridge crest.

Take a real case: Tom Higgins owned much of the outlying ground that the Calumet & Arizona took over in Bisbee. There was no ore on the surface, and none was found for several hundred feet below. He was poor but held on, and finally after more than 10 years he sold to Mr. Cole for much money. He is a Los Angeles millionaire today. Under the proposal to make him find ore within seven years he would now be Tom Higgins, shift boss or foreman, with only his pay. All his faith and courage would have availed him nothing.

No, I am most emphatically in favor of granting a patent to the man who performs his work in good faith, whether he has found mineral or not. Otherwise a camp like Bisbee would be a checkerboard of patented and unpatented claims. It would make a practical dead letter of the permission to concentrate development or assessment work on a single claim for the benefit of a group, unless the original discovery work was an actual discovery.

It costs more to acquire public land under the mineral act than in any other way. For a full claim the cost now is about $40 per acre, including work. Some fractions in Bisbee have cost at the rate of $7,000 per acre to patent.

If you divorce surface and mineral rights, you get rid of the town-site locator, timber grabber, etc.

I suggest: "Actual discovery of a valuable mineral deposit shall not be necessary to the valid location of a claim, nor shall the failure to find such deposit within seven years, or less if patent be desired sooner, prevent the owner from making final entry thereon, provided he has fulfilled in good faith the requirements of the law regarding assessment work, etc." This is very important, and I am glad that another member raised the question.

I am in favor of the 10-acre claim, square in form, conforming with subdivisions of sections on surveyed land and having N-S and E-W lines on unsurveyed. The smaller the unit claim is the easier it is to locate just the ground one wants. I like the hectare.

There ought to be some limit to the number of claims locatable by one man, but where would you draw it? A limit fair to Oatman might be disastrous in Miami, Bisbee or Grass Valley. I am against a specific numerical limit, but in favor of producing a limiting effect by rigorously enforcing all laws about assessment work, monumenting, recording, etc.

Existing regulations about monumenting should be stricter. All monuments should be as permanent as a Mexican *mojonera* and should be plainly marked and recognizable from the description on record in the recorder's office, and in the local Land Office. It will do little good to prescribe Land Office records if the ground cannot be identified from them.

Notice should be recorded within 90 days as now, but failure to do so should forfeit the ground. That is ample time in the main territory of the United States. I do not know about Alaska. Every prospector knows where to find the county recorder; he knows less of the Land Office. I presume the recording of identical data in the two places is to be specified. Why not let the recorder forward a certified copy of the location notice to the Land Office as soon as the record is made? He could collect the Land Office fee also. This would save the simple-minded some bewilderment.

I am strongly in favor of permitting the concentration of assessment work in one claim of a group, of crediting excess work in one year to a subsequent year and of permitting an equivalent sum to be paid into the Land Office in lieu of work.

Holders of claims doing assessment work should be required to file an affidavit of labor with vouchers. When a man does his own work, it is up to his conscience to say what is a day's work, so there should be a minimum footage prescribed for blasting and for picking ground, since it is a common trick to do annual labor in soft talus and gulch wash.

The main lines of patent procedure may as well remain as now. But how about the advertising of the application? At present the claimant is required to advertise for 60 days at his own expense for someone to dispute his title. If the law be rigidly enforced to procure clear monumenting and recording in the Land Office as requisite to a clear title, the mineral surveyor could be supplied with records of unpatented claims by that office as he is with maps of patented ones by the Surveyor General's office. Lack of records of conflicting locations should be taken as prima facie evidence that none exists that is valid. Under such conditions would it be necessary to retain the provision for advertising? If it is retained, need it be for 60 days? Improvements for a 10-acre claim would be $250 instead of $500.

E. The suggestions that the mineral rights should not pass except under laws relating to mines and minerals and no other form of patent shall convey valuable minerals, with certain exceptions, appeals to me as wise. Perhaps provisions and regulations with regard to the right of a prospector to go on land owned by others should be included.

I fear that a requirement that the claims shall conform to the legal subdivisions on surveyed land would prove to be a hardship in many cases, involving considerable added expense and frequently involving distinctly added uncertainty. The Imperial Valley in California was surveyed many years ago. It was an open, treeless, shrubless plain over much of its extent. When settlement started there, it was found extremely difficult to locate the section corners. A second survey was made, incompletely covering the district, and the entrymen tried to use one survey or the other, often not knowing what they were using. Endless complications followed and the Government in the end surveyed tracts located by the different people and gave them lot or tract numbers and abandoned the attempt of using sections or parts thereof. I know a case where a man was farming a tract of land and all the records would indicate that the land he owned was located a mile or two away. Eventually these things were straightened out with reasonable justice to the people interested, but the process was long and tedious and expensive for the settlers and the Government.

Much of the mineral land of the United States is unsurveyed, and where it is surveyed it would be frequently the work of days for a surveyor acquainted with the country to locate a properly established corner and occasionally the nearest corner would be found several miles away. The old surveys were not accurately done always, and later on some other surveyor might find another corner in another direction. Surveying from a particular tract to one of these corners might indicate that the ground desired should be described in one way, while surveying from the other corner might indicate it should be described in another way. The moving of a man's ground a few hundred feet might be vital. As a whole my opinion is that the use of the legal subdivisions on surveyed land would prove unsatisfactory. If the use of legal subdivisions is abandoned, it seems that there should be no provision requiring that the boundaries of claims run north and south and east and west. As to the size of the claims, I would prefer 1,320 or 1,500 ft. square.

I would not limit the number of claims that any individual could locate, but I think added effort should be made to enforce assessment work being done yearly.

E. D. Gardner has some good arguments why mineral discovery should be made prior to location. Would it not be practicable to insist, in case mineral discovery was not made prior to location, that work should be prosecuted continuously on the claims or on a group until discovery is made?

F. The requirement in our present laws of the antecedent discovery has been one of the greatest sources of abuse. The fact that it has generally been abandoned by common consent is the best reason why now it should be abandoned legally. It will be well enough to require it still on land not classified as mineral, but let the Land Office see to it that a real discovery is made. I think there should further be a prospecting right. Suppose a man had reason to believe that he might find ore in depth in some classified Government land, and desired to drill for it. He should be given the right to do so and should be protected in the meanwhile.

On land classified as mineral, claims should be locatable without discovery. Require the annual assessment work to be honestly performed and duly recorded, making delinquency in this matter as much of a cloud on title as is nonpayment of taxes on any real estate. This would check land-grabbers waiting for the unearned increment.

I am strongly in favor of the square 10-acre claim, conforming to public-land survey lines, if possible, but with north and south lines anyway. The small claim is most elastic. It enables a man to take up a small piece of land if that is all he needs. If he needs more, all he has to do is to locate more tens. What is the difference between locating four tens and one forty? If it be merely the trouble of monumenting, etc., let it be provided that when anybody locates four 10-acre claims in a 40-acre square he need mark only the exterior corners and lines of the group.

As to north-and-south lines, the purpose is manifestly to do away (in new districts) with the crisscross patchwork of a present mining-camp claim map. If somebody had to locate on a vein striking NW-SE, he would simply set his north-and-south square claims in steps. There might be some waste corners, but with 10-acre claims this would not be a serious matter. It is one of the advantages of the small claim.

Chronology of Mining for September, 1916

Sept. 5—Interstate Commerce Commission ordered changes in rates and practices in shipping iron ore from lower Lake Erie ports to western Pennsylvania, Ohio and West Virginia.—New flotation plant of Buffalo Mines Co. put into operation.

Sept. 6—United States Steel common stock reached and passed par for first time in its existence.

Sept. 8—International Nickel Co. announced Port Colborne, Ont., as site for its new refinery.

Sept. 11—First section of Anaconda's new electrolytic zinc plant at Great Falls placed in operation.

Sept. 14—Claims of H. E. Lee against California Trona Co.'s Searles Lake locations dismissed by the court.

Sept. 15—Calumet & Hecla distributed to stockholders its holdings of Tamarack, amounting to about 20,000 shares.—Superior Copper Co. declared initial dividend.

Sept. 19—Eight Mother Lode mines in Amador County, California, closed on account of strike.

Sept. 23—Sale of 448,000,000 lb. copper by American producers to British Ministry of Munitions.

Sept. 24—Fire started in Clay mine of Arizona Copper Co.

Sept. 25—Arizona Commercial declared initial dividend.

Sept. 29—Decision in case of Minerals Separation, Ltd., vs. Miami Copper Co. rendered in United States District Court.

Comprehensive Court Decision

By A. L. H. Street*

The recently announced decision of the United States District Court for the District of Montana in the case of Clark-Montana Realty Co. vs. Butte & Superior Mining Co., 233 Federal Reporter, 547, lays down a score of principles of mining law covering a wide range, as shown by the following summary of the more important points decided:

Discovery of a mine with intent to claim the underlying minerals being the principal element of a valid mine location, a location in Montana is not to be deemed to be void because the declaratory statement, required by the state law to be recorded, was defectively verified. "These statutes are of no more force and effect than miners' rules. Both are authorized by the one Federal statute. The better, if not prevailing, rule always has been that, if the recordation law does not expressly provide forfeiture for failure to record, the location is valid though not recorded."

When no adverse claim is filed against an application for a patent covering a mining claim, the patent is not conclusive against the rights of the locator of an adjoining claim as to conflicting area. The Federal Land Department does not determine priorities. A prior locator may abandon a conflict area without giving rise to any presumption to his prejudice respecting the remainder of his claim.

"Locations are of surface, including veins. In so far as there is no conflict, if the United States does not avoid a location for defective compliance with local rules, and issues patent, the patent vests all the extralateral rights appropriate to the veins within that surface and as of the date of discovery, of which no third party can complain."

When, on the trial of a suit to quiet title to lode-mining land, the defendant admits that the apex of a certain vein crosses the common side line of the conflicting claims, that from its apex in plaintiff's claim it extends on its dip under defendant's claim, and that the body of ore in dispute under both claims and in places bisected on the strike by the common side line is in such vein, the burden falls on defendant to prove a prior location and to show that another vein having its apex in defendant's claim united with the first-mentioned vein above a part of the ore claimed.

There can be but one set of end lines for a mining claim, and if the located end lines fixed extralateral rights upon one vein, they fixed them upon all veins.

The damages recoverable for innocent removal of ore in place belonging to another are to be measured on the basis of the amount which the defendant ought to have received for the removed minerals, less the reasonable cost of mining and marketing, or the actual cost if less than the reasonable cost. The value of tailings are not to be considered if they had no market value at the time of the removal of the minerals.

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Calumet & Arizona Mines

The Calumet & Arizona Mining Co. is at present operating five mines in the Warren District, Ariz. The data given below in regard to these mines was prepared for the recent A. I. M. E. visitors.

DATA OF THE MINES COMPOSING THE CALUMET & ARIZONA GROUP

	Oliver	Cole	Hoatson	Junction	Briggs	Total
Date started shaft sinking	1903	1903	1905	1903	1902	.....
First ore shipped	Nov., 1904	Oct., 1905	Nov., 1906	June, 1907	Dec., 1910	.....
Number of men	150	350	50	640	340	1,530
Depth of shaft	1,375.5 ft.	1,480 ft.	1,680 ft.	1,837.5 ft.	1,630 ft.	8,003 ft.
Tonnage, present	250	500	200	1,350	650	2,950
Equipment—headframe	75-ft. steel	Steel	Steel	75-ft. steel	Timber	.....
Hp. boilers	1,500	1,000	4,500	3,250	500	10,750
Hoist	4-cylinder, 16x42 in.	4-cylinder 16x42-in. (idle)	17x48-in. (idle)	4-cylinder, 16x42 in. 2-cylinder, 18x42 in.	18x42-in. Corliss	.....
Compressor	Two-stage, 3,500 cu.ft. Single-stage, 950 cu.ft.	.....	.....	Assorted*	.....	.....
Generator	2,100-kw. (total)	.....	.....	.....	.....	2,100-kw.
Pump	Nordberg jet condenser and 3 double-acting plunger	Two 14x26-in. Two 7x18-in.	.....	Assorted†	.....	.....
Water pumped, gal. per min.	.....	500 gal.	.....	3,500 gal.	.....	4,000

*Nordberg two-stage, 5,080 cu.ft. per min.; Nordberg two-stage, 3,500 cu.ft. per min.; Ingersoll single-stage, 888 cu.ft. per min.; total, 9,468 cu.ft. per min. †Pumps—1,800 level: One 18&28&47&12x24 Prescott duplex pot-form slide-valve triple-exp., capacity 1,500 gal. per min.; one 15&23&39&10x24, same type, capacity 1,000 gal.; one 15&23&39&12½x24 Prescott duplex pot-form rolling-valve triple-exp., capacity 1,500 gal. These three pumps all have independent jet condensers. They throw 800 ft. to the 1,000-level sump. There is also ordered one 6¾x24 Prescott duplex power pump with direct-connected 100-r.p.m. motor, capacity 1,488 gal. per min. against 2,200-ft. head. At 1,500 level: One 15&23&39&14½x24 Prescott Messabe type, rolling-valve, triple-exp., 2,245 gal. per min., independent jet condenser; one 18&34&8x36 Prescott cross-compound Corliss Messabe type, 1,500 gal. per min., attached condenser; one 16&30&14½x24 Prescott Messabe type slide-valve compound, independent jet condenser. These pumps all throw 500 ft. to the 1,000-level sump. At 1,000 level: Three 15&23&39&10x24 Prescott pot-form, slide-valve, triple-exp., 1,000 gal. per min. each, independent jet condensers; two 20&38&6½x36 Prescott cross-compound, Corliss, pot-form, capacity 1,000 gal. per min. each, attached condensers. These pumps all throw to the surface.

VARIOUS MINING METHODS EMPLOYED

	Oliver	Cole	Hoatson	Junction	Briggs
Soft carbonate and oxide ore.	Square-set Cut-and-fill	Square-set Cut-and-fill Top-slicing	Square-set	Square-set	Overhand stoping
Sulphide ore	.....	Mitchell slicing	Shrinkage	Gilman	Square-set
	.....	Shrinkage	Cut-and-fill	Cut-and-fill	Mitchell slicing

On account of the diversity of character of the ore, many mining methods are employed in these mines as shown in the above table.

The Atomic Weight of Dysprosium has recently been redetermined by C. W. Balke and E. W. Engle. According to a paper before the American Chemical Society, the alkali-sulphate separation was used on the original material, followed by fractional crystallization of bromate, ethylsulphate and nitrate. Dysprosium oxide was placed in a tared flask, weighed, dissolved in HCl and the chloride dehydrated, fused and weighed in the flask. Five determinations gave results from 164.116 to 164.357. The mean of the five, 164.228 is considerably higher than the present accepted value.

Editorials

Revision of the Mining Law

The Mining and Metallurgical Society of America is conducting a referendum of its membership on points involved in the proposed revision of the mining law of the United States and has requested all the other mining societies, state associations of mine operators, etc., to obtain a similar expression of the opinion of their memberships. The questionnaire that has been issued is published elsewhere in this issue. It is hoped that there will be a very full expression of opinion. If our readers who are not members of some regular organization through which they would naturally record their views care to write us on the subject, we shall be glad to summarize and report their opinions. Simply cut out the page of this issue on which the questions appear, write "yes" or "no" in the margin and mail to us. If anybody be concerned over the mutilation of his file, we shall have pleasure in replacing it, gratuitously, if requested to do so previous to the end of October.

The purpose of this referendum is to obtain data, based on a general consensus of opinion, to assist in the drafting of a new mining law, to be introduced in the next session of Congress. This follows the actions culminating in the convention in Washington last December and the subsequent hearings before the Committee on Mines and Mining of the House of Representatives. The mining societies had been asking for a commission to draft a new mining law. Congress in effect told them that it would not authorize a commission and if the mining men wanted a new law, to draft it themselves, Congress being disposed to enact what the majority wanted, but being indisposed to try to find out. This put the burden upon the mining men, and the Mining and Metallurgical Society of America having previously taken the lead in the matter has been endeavoring to crystallize ideas upon a constructive program and has been inviting and inspiring discussions during the last six months.

If the plan can be carried through on the lines that have been in mind, it will result in a novelty in legislation of this sort; that is, the introduction of a bill based upon free and open discussion and representing the wishes of the majority, rather than the drawing of one by a few persons, which the public at large has no opportunity to criticize until after it has been introduced, and is thrown open for discussion only in brief hearings before a Congressional committee in Washington that but few are able to attend.

When the Mining Engineer Cannot Collect His Pay

The mining engineer occupies an anomalous position in many respects. He is both a professional man and he is not. In the eyes of the law he has no such standing as the medical and legal men, but in his dealings with the world all are on the same footing. To speak of one important thing, all collect their fees if they can, but often have a lot of trouble in doing it. If the engineer, like the lawyer, is sufficiently independent to demand and receive a retainer before beginning on a job, well and good. He makes himself sure of something. The men of less established reputation, however, who are eager for commissions, generally think it is risky to insist upon a retainer, fearing that the prospective client may be so offended that he will go elsewhere. But it is always feasible and wise for anybody to insist upon an advance against his expenses, unless he is absolutely sure of his client. We have known of engineers, moreover, who have delivered their reports through their bankers, c.o.d.

A recent decision by the United States District Court for Massachusetts deals another blow to the mining engineer. In this case a mining engineer was regularly employed by a mining firm at an annual salary of $4,000. The firm became bankrupt. By the Federal Bankruptcy Act the claims of "workmen, clerks and servants" have priority in the distribution of a bankrupt's assets. The mining engineer claimed the benefits of that provision. The court held, however, that the earnings of a professional man are not properly described as "wages" and the man himself is not a "workman, clerk or servant" within that provision of the law. Some fine points are involved herein, but anyway, they seem to be unlucky for the unfortunate mining engineer.

Consumption of Explosives in Mining

With the metal mines of the United States producing an estimated 141,500,000 tons of various ores in 1916, a probable increase of 30,000,000 tons over 1914, the indicated increase in their consumption of high explosives is great. Upon the basis of the figures given by the United States Bureau of Mines of about 84,264,577 lb. of dynamite consumed in 1914, it is estimated that during 1916 the consumption will reach the total of at least 103,144,500 lb., an increase of 23%.

From confidential correspondence with a number of the larger mining companies it is apparent that 40% dynamite is favored by the majority. According to the figures of the du Pont powder company, the price of 40% nitroglycerin dynamite and gelatin advanced from $11.25 to $19.75 per 100 lb. from 1914 to July 1, 1916. This is an increase of 8.5c. per lb., or 75.5%.

It is of course impossible to segregate the entire quantity of explosives consumed into classes of 30, 40, 50 and 60% and state, from the meager data obtainable so far, their exact value. If we assume that the entire amount of 103,144,500 lb. of dynamite estimated as consumed was 40% costing $19.75 per 100 lb., we shall not be far wrong in assuming that the value of the explosives used in metal mining in the mines of the United States in 1916 will reach at least $20,371,000. On the basis of the 1914 price of $11.25 per 100 lb., the total cost would be only $11,604,000. In other words, the difference between these two extremes, or $8,767,000, is the sum saddled upon the mining industry since the war began, as a sort of war tax.

The firing of the previously indicated quantity of explosives would require about 202,000,000 ft. of fuse. At the current price of $6.50 per 1,000 ft., the value is $1,313,000. Detonation of the estimated quantity of dynamite would require about 25,952,000 caps, which at present prices of No. 6 caps—$17 per thousand—would cost about $441,184. The cost of fuse has increased 39.7% and of caps an even 100% since the war began.

In their confidential reports to the *Journal*, the several mining companies indicate a shifting from 40% nitroglycerin and gelatin to 30, 35 and 40% ammonia powders. The du Pont company especially has for some months been advocating the use of ammonia powder in place of the nitroglycerin mixtures.

The pinch of increased powder costs is being felt most by those metal-mining districts not radically affected by war-boosted prices of their product. Practically all the gold and silver mining districts are thus affected. It is probable that the market for ammonia powders costing about 5c. per lb. less than nitro powders is now about one-third of the total, or 30,000,000 lb. This one-third is used advisedly, since reports from many companies indicate that the change is well under way.

The Question of Pulp Elevation

To the interested onlooker it is a matter of some surprise that engineers responsible for mill design have not been able to agree upon the most economical method for elevating wet pulps. The controversy between centrifugal pumps, on the one hand, and belt-and-bucket elevators, on the other, is still alive, while advocates of air lifts and piston pumps are still pointing out the merits of these devices. In general, it may be said that those engineers brought up under the South African influence mostly favor the centrifugal pump, while those under the American influence incline toward the elevator. The air lift, as a pulp elevator, does very well in some instances, but it has limitations that exclude it from a consideration of the problem in general. The limited ability of the air-lift mechanism, combined with its submergence requirement and its rather high power consumption, confines its use to those instances where the head is not great. Some years ago there was a great deal of talk in favor of the triplex power pump for elevating pulps, but one does not hear so much of it at the present time. Apparently the wear caused by fine ore particles was such that the power pump was unable to meet the requirements so far as endurance is concerned.

As between the centrifugal pump and the bucket elevator, to which the controversy is practically limited now, something may be said for each type. The centrifugal pump is cleaner and easier to operate, whereas the belt elevator is probably cheaper to install. It comes down to a question of final cost, however, which is the critical point of disagreement. Theoretically, it would appear that the belt-and-bucket elevator is more economical. Its power requirement must be less than that of the centrifugal pump, since only sufficient power is required actually to lift the weight of the pulp to be elevated, plus, of course, the small amount lost in transmission. The belt elevator is practically a balanced device, the weight of the belt and bucket used in lifting pulp at any moment being counterbalanced by the empty buckets and belt on the down side of the elevator. In addition, it is not difficult so to design an elevator that its bearings may be out of reach of pulp, and they may be of a type such as to reduce friction loss to a minimum.

With centrifugal pumps, on the other hand, in addition to the weight of the column of pulp lifted, there is the high friction loss of heavy pulp in pipe and the loss of efficiency due to imparting motion to the pulp under conditions where clearance is required. Again, the centrifugal pump is essentially a high-speed machine and therefore not economical of power. Its bearings may be protected from attrition by pulp particles, but this result is neither easy nor sure. Moreover, there is high wear on the pump shell, or its lining, due to the attrition of rapidly moving ore particles. Theoretically, at any rate, the balance of argument seems in favor of the elevator, although as usually built it is a messy and uninteresting piece of machinery. It is to be hoped that engineers will, before long, take up this question and settle, once for all, the doubt as to which is the most efficient appliance for elevating pulps.

The milk business is far from our own field of interest, but the recent events in it are of economic concern to everybody. The farmers producing the main milk supply of New York City combined to suspend supply unless the distributing companies paid the price they demanded. The companies resisted until the cutting-off of supply verged upon the murder of babies, and then they gave in. Sooner or later the people will pay. Query: Why may not the producers of copper, gasoline, etc., combine to exact the prices they would like to get? The Sherman law as amended by the Clayton law apparently permits some groups to do what others may not. It is much as if the Sullivan law of New York should be fixed up to read that nobody may carry a gun except Italians.

We are rather appalled by the impudence of the mining companies of the United States that have property interests in Mexico in appealing to the international committee for a hearing of the wrongs. Do not they know that the Washington Administration has repeatedly told them that they had no business to be interested in Mexico and that their opinions are not wanted? Do not they know, moreover, that the purpose of the commission is mainly political, with probably the idea in the back of the heads of the Mexicans that maybe they can pave the way for a loan?

The appointment of General Goethals to the head of the commission to investigate the working of the railroad eight-hour law is ideal. That cannot be said of the other members. Commissioner Clark is an esteemed member of the Interstate Commerce Commission, but as an ex-labor leader he has no more right to be on the eight-hour commission than an ex-railway president.

The latest development in the iron industry is a heavy demand for pig iron for export. Heretofore the foreign orders have been chiefly for finished steel and for steel billets; but apparently the European steel works are now in better condition to supply material than the blast furnaces. The export call is chiefly for basic iron and large orders have been already placed.

BY THE WAY

On the occasion of the recent trip of the A. I. M. E. it was remarked, in looking over the mine managers and engineers assembled at the various meetings in Arizona, that it is verily the day of the young man in handling big mining operations in the Southwest. But they are all prematurely gray.

⁂

Scores of men who got the public's money in the old days of speculation in mining shares may be seen in all the resorts of lower New and Broad streets, says the New York *Sun*. From outward appearances they are prosperous beyond previous experience. The stocks they offer, the public was never more eager to buy. Their offices are crowded with customers. The mails and wires bring in orders constantly. Automobiles carry them up town. In fact, they are so prosperous that they are beginning to fall out.

⁂

Frank A. Vanderlip in a recent public address expressed himself boldly as follows:

It is my belief that war itself is scarcely more dangerous to a nation or more deadly to industrial progress than are some of the influences at work within our own boundaries. There is a prevailing idea that the wages-earning class is interested in restricting production. They hold to that view because they believe the employer is a natural enemy or, more often, that there is not enough work to go around to all laboring men and that it should be made to go as far and last as long as possible.

Such a fallacy, generally held, is actually worse than war, for when war runs its course, recuperation can follow, but when the idea of restriction of production as a means to obtain individual prosperity becomes fixed in men's minds, it has the same effect upon production that a perpetual drought would have upon grain fields.

Whatever controversies there may be about wages or other divisions of the product, there ought to be an agreement upon honest, sincere effort to increase all production for the common good. Not to coöperate to this end is to be disloyal to the community. The betterment of industrial conditions will come in the future, as it has come in the past, by increasing the individual output, never by policies restricting output.

This is sound economics.

⁂

The joint commission which has been meeting at New London to talk over the differences between the Washington Administration and Venustiano Carranza is shortly to adjourn to Atlantic City, where there are many delightful diversions, more, perhaps, than the Connecticut city can offer to them, says the New York *Sun*. Later in the season they should not fail to visit Lakewood, another agreeable fall resort. Were it not for the uncertainty of General Carranza's temper, sojourns at White Sulphur Springs and Palm Beach might be planned conveniently. So far as Mr. Wilson is concerned, the commissioners could easily arrange their recreation as far ahead as Mar. 4, 1917. The business of the commission has proceeded much faster than could have been anticipated. Already the representatives of Carranza have demanded enactment of stricter neutrality laws by the United States and have presented a list of atrocities for which we are to blame. Little is left for our commissioners except to make the necessary promises of laws to prevent Mexicans from fighting each other. The amount of the indemnity we shall pay Carranza can be settled along with the size of the loan we are to arrange for him. These are mere details of the Wilson policy of huckle, truckle and knuckle in Mexico.

September Mining Dividends

Dividends disbursed in September, 1916, by mining companies reached a very high total, as has been the case every month during the year. Payments by 40 United States mining companies making public reports amounted to $26,799,712, as compared with $10,708,720 in the corresponding month last year. This is the largest amount paid out in any month during 1916, with the exception of June, when $27,917,090 was disbursed. The large prophyry companies making quarterly payments are represented in both of these months. The reason for the difference in favor of the earlier month is probably that Butte & Superior paid an extra dividend of $10, as compared with $6 in September, and the New Jersey Zinc Co. paid an extra dividend amounting to $1,750,0000 in June, for which no corresponding dividend was declared for September. The Centennial and Cerro Gordo payments were the first made on those shares.

United States Mining Companies	Situation	Per Share	Total
Argonaut Cons., g	Calif.	$0.10	$20,000
Bunker Hill & Sullivan, l.s.	Ida.	.50	163,500
Bunker Hill Con., g	Calif.	.02½	5,000
Butte & Superior, z	Mont.	6.25	1,812,931
Caledonia	Ida.	.63	78,150
Calumet & Ariz., c	Ariz.	2.00	1,283,204
Calumet & Hecla, c*	Mich.	20.00	2,000,000
Cardiff, l.z	Utah	.25	125,000
Centennial, c	Mich.	1.00	90,000
Cerro Gordo, z.s	Calif.	.02½	25,000
Champion, c	Mich.	6.40	640,000
Chino, c	N. M.	2.25	1,957,455
Cons. Interstate-Callahan	Ida.	1.50	697,485
Copper Range, c	Mich.	2.50	985,003
Cresson Cons., g	Colo.	.10	122,000
Eureka Hill	Utah	1.00	10,000
Federal Min. & Sm., pfd	U. S.	1.00	120,000
Golden Cycle, g	Colo.	.02	30,000
Grand Gulch, c	Ariz.	.03	7,195
Hecla	Ida.	.15	150,000
Hercules	Ida.	.20	200,000
Homestake, g	S. D.	.65	163,254
Kennecott, c	.....	1.50	4,170,874
Magma, c	Ariz.	.50	120,000
Nevada Con., c	Nev.	1.00	1,999,457
North Star, g	Calif.	.20	50,000
Old Dominion, c	Ariz.	3.00	486,000
Oroville Dredging Co	.....	.12	82,385
Prince Cons., g.s	Nev.	.05	50,000
Quincy, c	Mich.	4.00	440,000
Ray Con., c	Ariz.	.75	1,182,884
St. Joseph Lead	U. S.	.75	1,057,050
Socorro, g	N. M.	.05	18,865
United Globe, c	Ariz.	18.00	414,000
United Verde, c	Ariz.	1.50	450,000
Utah Apex, c	Utah	.25	132,050
Utah Con., c	Utah	.75	225,000
Utah Copper	Utah	3.00	4,873,470
Yellow Pine, l.z.s	Nev.	.10	100,000
Yukon Gold, g	.....	.07½	262,500
Iron, Metallurgical and Holding Companies	**Situation**	**Per Share**	**Total**
Am. Sm. and Ref., com	U. S.	$1.50	$751,620
Am. Sm. and Ref., pfd	U. S.	1.75	875,000
Crucible Steel, pfd	U. S.	3.00	1,487,352
General Dev	U. S.	1.50	180,000
Inland Steel Co	U. S.	2.00	198,194
Internat. Nickel	U. S.	1.50	2,510,076
Lackawanna Steel	U. S.	1.50	521,250
Nat. Lead, com	U. S.	1.00	206,554
Nat. Lead, pfd	U. S.	1.75	426,433
Old Dominion of Me. (holding)	.....	3.00	880,059
Phelps, Dodge & Co	U. S.	8.00	3,600,000
St. Mary's Min. Land	Mich.	2.00	320,000
U. S. Steel Corpn	U. S.	2.25	11,436,806
Yukon-Alaska Trust	.....	1.00	203,433
Canadian Companies	**Situation**	**Per Share**	**Total**
Dome Mines, s	Ont.	$0.50	$200,000
Hedley, g	B. C.	.50	60,000
Hollinger, g	Ont.	.05	120,000
Kerr Lake, s	Ont.	.25	150,000
Min. Corpn. of Can	Ont.	.15	311,256
Right of Way, s	Ont.	.005	8,428
Standard Silver Lead	B. C.	.02½	50,000

* In addition to its cash dividend, Calumet & Hecla distributed in September its holdings of Tamarack shares, amounting to about 20,000, on the basis of 1 to 5.

Iron, metallurgical and holding companies paid $23,596,777, as compared with $6,900,586 a year ago.

Canadian companies paid $899,678, as compared with $720,000 in 1915.

The totals for the first nine months of the year are as follows: Mining companies, $134,996,315, as against $51,399,883 in 1915; iron, metallurgical and holding companies, $89,994,144, as against $61,726,344 in 1915; Canadian, Central American and Mexican mines, $15,438,240 as against $6,082,120 in 1915.

Personals

J. Parke Channing is at Miami, Ariz.

C. M. Weld returned to New York Oct. 9 from Cuba.

G. A. Morrison, lately at Gillham, Ark., is now in Chicago.

R. W. Bissell has gone to Greensburg, Penn., from New York.

W. J. Kee, lately at Blue Ridge, Ga., is now at Perth Amboy, N. J.

Hiram W. Hixon, lately at Worthington, Ont., is now in Philadelphia.

H. L. Klinck, recently at Charlotte, N. C., is now at Birmingham, Ala.

E. D. Morton has gone from Los Angeles, Calif., to the Mammoth mine at Shultz, Ariz.

F. E. Marcy has opened offices in the Atlas Building, Salt Lake City, Utah, as consulting engineer.

H. G. S. Anderson is now with the Chino Copper Co. at Hurley, N. M. He was recently at Muskogee, Okla.

Mr. and Mrs. Bradley Stoughton left the A. I. M. E. excursion party at La Junta, Colo., to spend two weeks camping in Estes Park.

S. B. Patterson, for 12 years past superintendent of the Robesonia Iron Co., Robesonia, Penn., has resigned. He will retire from active business after more than 50 years' service.

Henry Bruere, of New York, has been chosen a director of the Granby Consolidated Mining, Smelting and Power Co. in place of Jay P. Graves, of Spokane, Wash., retired.

A. P. Anderson, S. J. Jennings and **F. D. Weeks,** all officers of the United States Smelting, Refining and Mining Co., have been in Arizona visiting mines of the company near Courtland.

J. W. Gocher has been appointed superintendent of the furnace and mines of the Robesonia Iron Co. at Robesonia, Penn. He was at one time with the Cambria Steel Co. at Johnstown.

H. H. Howry, formerly with the United States Gold Corporation, Boulder Cañon, Colo., is engaged in experimental metallurgical work for the Chile Exploration Co. in New York.

H. J. Stander, flotation engineer for the Yaryan Resin and Turpentine Co., of Brunswick, Ga., and Gulfport, Miss., has been visiting mines in Utah on his return from Alaska and British Columbia.

H. P. Henderson, of New York, after spending a few weeks on professional business in Arizona will leave there about Oct. 15 for Cuba and the end of the month will find him back in New York.

William G. O'Malley, master mechanic, Pittsburgh Crucible Steel Co., Pittsburgh, was appointed works manager of that concern Oct. 1, and now has charge of all operating and construction work at Midland.

Myron A. Folsom, for 17 years attorney for the Bunker Hill & Sullivan Mining Co., with office at Spokane, Wash., has gone to San Francisco, where he will take charge of all business of the company not handled by the executive officers.

Jay P. Graves, who was one of the organizers of the Granby Consolidated Mining, Smelting and Power Co., and till two years ago vice-president and managing director, retired as a director also at the annual meeting, Oct. 4, in New York.

Dr. L. D. Ricketts, C. E. Mills, Norman Carmichael, John C. Greenway and several others of the Arizona contingent left the A. I. M. E. excursion at Grand Cañon to return by way of Jerome in order to visit the United Verde Extension property.

Dr. C. Offerhaus has resigned his position with the Humboldt Engineering Co., Coln-Kalk, Germany, and has taken a position with Beer, Sondheimer & Co., Frankfurt am Main. He will, however, continue to act for the Humboldt Co. as consulting engineer.

Jesse Scobey, assistant to the president of La Luz & Los Angeles Mining Co., has removed his office with that of the company from Pittsburgh, Penn., to 511 Fifth Ave., New York. Mr. Scobey leaves New York this week for Bluefields, Nicaragua, on his way to make an inspection of the mines.

Louis L. Chapman, mining engineer, formerly with Oliver Iron Mining Co., and with Arthur Iron Mining Co., has severed his connection with the latter company and has associated himself with the Indiana Laboratories Co., of Hammond, Ind., as consulting mining engineer.

E. P. Mathewson, who for a number of years has been manager of the Washoe Reduction Works of the Anaconda Copper Mining Co., has resigned to become general manager of the British-Canadian Nickel Co., which owns the Murray and other nickel mines in the Sudbury district of Ontario.

V. E. Lednicky has been appointed chief geologist of the Philippine Bureau of Science to fill the position recently vacated by resignation. Mr. Lednicky is a graduate of the University of Kansas, and during the past two years has been connected with the Bureau of Science as mining engineer. The present appointment comes as a reward for the excellent work which he has done.

Burt B. Brewster, for the past two years with the Sullivan Machinery Co. as manager in Alaska, with headquarters at Juneau, has been transferred to Salt Lake City, to become manager at the company's branch office at that point, succeeding H. E. Moon, resigned. Walter F. O'Brien, for some time past associated with Mr. Brewster at Juneau, will take his place as local manager for Alaska.

Obituary

Adolph J. Zang, vice-president of the German-American Trust Co., and president of the Vindicator Gold Mining Co., of Cripple Creek, died Sept. 28 in Denver.

John Sanford Taylor, mining engineer, who followed his profession in the Porcupine district in Ontario before enlisting for service overseas in April, 1915, is reported killed in action. He was a graduate of Toronto University and leaves a mother and sisters resident in North Tonawanda, N. Y.

A. C. Hall died in Chile, Oct. 2, of typhoid fever. He left the United States in June last to take charge of the smelting plant at Caldera, in that country, which the American Smelting and Refining Co. had then recently furnished. He was well known in this country and in Mexico, where he was for some years superintendent of the smeltery at Aguascalientes. He had been with the American Smelting and Refining Co. for 15 years and was a very popular man.

Bedford McNeill, widely known as a mining engineer and a compiler of cable codes, died in London, Sept. 19. He was one of the founders and a prominent member of the Institution of Mining and Metallurgy, and was its president in 1913-14. Shortly after his graduation from the Royal School of Mines, Mr. McNeill was in 1880 appointed assistant to the late Mr. John Darlington. He had a wide experience in mining in Europe and America. His cable codes, the first edition of which was published in 1893, are in use all over the world.

Societies

The American Mining Congress, which opens its nineteenth annual convention at Hotel La Salle, Chicago, Nov. 13, plans to devote considerable attention to the oil industry. The general meetings are to be held in the mornings, and the sections devoted to oil, coal, lead and zinc, copper, and precious metals, are to meet every afternoon in their own assembly rooms at the hotel. One of the special questions in the oil section will be that relating to the rights of the Western oil claimants upon lands withdrawn from entry and upon which large development has been made.

Trade Catalogs

Matteson Mine Cars. Joshua Hendy Iron Works, San Francisco, Calif. Bulletin No. 125. Pp. 16; 7x10 in. Illustrated.

Pumping Engines. Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin No. 1637. Pp. 74; 8x10½ in. Illustrated.

Pulverized Coal Equipment. Lehigh Car Wheel and Axle Works, Catasauqua, Penn. Catalog No. 71. Pp. 28; 8x10½ in. Illustrated.

All-Steel Jaw Crusher. Allis-Chalmers Mfg. Co. (Mining Machinery Dept.), Milwaukee, Wis. Bulletin No. 1,810. Pp. 12; 8x10½ in. Illustrated.

Brass and Iron Valves, Fittings, Etc., for Steam, Gas, Water, Air and Oil. The Kelly & Jones Co., Greensburg, Penn. Catalog O. Pp. 470; 5x7½ in. Illustrated.

Oxy-Acetylene Welding and Cutting Apparatus. The Alexander Milburn Co., 1418-28 W. Baltimore St., Baltimore, Md. Catalog No. 24. Pp. 32; 8x10½ in. Illustrated.

Extracts from the Technical Press is the title of a 32-page booklet issued by the Hardinge Conical Mill Co., 120 Broadway, New York, which contains reprints of articles from the "Engineering and Mining Journal" and other papers relating to the Hardinge mill.

Industrial News

General Naval Stores Co., New York, has issued a booklet on flotation oils that gives some useful information about oils, in general, for flotation and about G. N. S. oils in particular. It will be sent to all applicants upon request.

A. Leschen & Sons Rope Co. has recently sold to the Queen of the West Mines Co., Cornucopia, Ore., a two-bucket gravity aërial tramway, 3,200 ft. long, with a capacity of 6 tons per hr. The company has also supplied a two-bucket tramway, 800 ft. long, to the Cottonwood Coal Co., of Lehigh, Mont.

New Patents

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ABRASIVES—Process of Treating Certain Aluminous Abrasives. Thomas B. Allen, Niagara Falls, N. Y., assignor to General Abrasive Co., Niagara Falls, N. Y. (U. S. No. 1,199,041; Sept. 26, 1916.)

ALLOY of Copper (95.5%), Iron, Tin, Etc. Joseph Monville, Hubbell, Mich., assignor of one-half to Joseph J. Ethier and one-fourth to William Kline, Hubbell, Mich. (U. S. No. 1,199,200; Sept. 26, 1916.)

CRUSHERS—Improvements in Rock Crushers. E. H. Moyle, Los Angeles, Calif. (Brit. No. 3,705 of 1915.

DRILLS—Improvements in Rock Drills and Like Machines. G. Constantinesco, London, and W. & W. & W. Haddon, London, E. C., England. (Brit. No. 4,350 of 1915.)

ELECTRIC FURNACES—Improvements in or Relating to Electric Furnaces for Metallurgical or Other Purposes. Hans Nathusius, Upper Silesia, Germany, and Westdeutsche Thomasphosphat-Werke G. m. b. h., Berlin, Germany. (Brit. No. 13,951 of 1914.)

MANGANESE ALLOYS—Improvements in the Production of Manganese Alloys. Th. Goldschmidt, Essen-Ruhr, Germany. (Brit. No. 4,455 of 1915.)

MELTING FURNACES—Improvements in Metal-Melting Furnaces. I. Hall, Birmingham, Eng. (Brit. No. 3,874 of 1915.)

NITROGEN—Process for Fixing Nitrogen by Means of Ferro-Aluminum or Other Ferro-Alloys. Ottokar Serpek, Paris, France, assignor to Société Generale des Nitrures, Paris, France. (U. S. No. 1,198,965; Sept. 19, 1916.)

NITROGEN—Process for the Fixation of Nitrogen by Means of Ferro Aluminum. Paul Bunet, Paris, France, assignor to Société Generale des Nitrures, Paris, France. (U. S. No. 1,196,657; Aug. 29, 1916.)

OIL AND GAS—Method of Recovering. Frederick Squires, Marietta, Ohio, assignor to Walter Squires, Zanesville, Ohio. (U. S. No. 1,198,078; Sept. 12, 1916.)

REFRACTORIES—Manufacture of Refractory Articles. Thomas B. Allen, Niagara Falls, N. Y., assignor to The Carborundum Co., Niagara Falls, N. Y. (U. S. No. 1,197,327; Sept. 5, 1916.)

REFRACTORY—Corrosion-Resisting Refractory. Paul Ralph Hershman, Chicago, Ill. (U. S. No. 1,198,033; Sept. 12, 1916.)

REFRACTORY—Production of Refractory Materials. Paul R. Hershman, Chicago, Ill., assignor to The Mineral Products Co., New York, N. Y. (U. S. No. 1,197,626; Sept. 12, 1916.)

Assessments

Company	Delinq.	Sale	Amt.
Alpha, Nev.	Oct. 25	Nov. 15	$0.03
Andes, Nev.	Oct. 11	Nov. 1	0.02
Beaver Mines, Utah	Sept. 30	Oct. 21	0.0025
Blue Bell, Ida.	Oct. 9	Nov. 9	0.002
Blue Bull, Nev.	Oct. 16	Nov. 20	0.01
Blue Star, Ida.	Sept. 25	Oct. 21	0.02
Bull Valley, Utah	Oct. 10	Oct. 31	0.004
Cash Boy, Nev.	Sept. 1	Oct. 15	0.01
Chief Cons. Ext., Utah	Oct. 10	Nov. 1	0.002
Consolidated Imperial, Nev.	Oct. 25	Nov. 15	0.01
Con. Virginia, Nev.	Sept. 29	Oct. 20	0.05
Demijohn, Utah	Oct. 21	Nov. 10	0.005
Diam. Blk., Butte, Nev.	Oct. 12	Nov. 18	0.01
Eagle Mountain, Ida.	Oct. 2	Nov. 4	0.001
Four Timbers, Ida.	Oct. 1	Nov. 1	0.002
Giant, Ida.	Oct. 5	Nov. 9	0.003
Gold Bond, Utah	Sept. 29	Oct. 24	0.001
Goldstrike Bon., Utah	Sept. 25	Oct. 16	0.0025
Great Western, Nev.	Sept. 26	Oct. 18	0.01
Independent, Ida.	Oct. 7	Nov. 7	0.005
Leonora, Utah	Sept. 27	Oct. 16	0.005
Manhattan Cons., Nev.	Oct. 9	Nov. 8	0.01
Military, Ida.	Oct. 25	Nov. 25	0.0001
Monarch-Pgh., Nev.	Oct. 23	Nov. 27	0.01
Murray Copper, Utah	Oct. 9	Nov. 8	0.001
Naildriver, Utah	Nov. 4	Dec. 4	0.01
New Balbic, Mich.	Oct. 14	.....	1.00
North Tintic, Utah	Oct. 10	Nov. 1	0.002
Ophir, Nev.	Oct. 25	Nov. 15	0.05
Rio Grande Grubstake, Nev.	Sept. 22	Oct. 31	0.002
Royal Copper, Ida.	Sept. 22	Oct. 22	0.001
Seg. Belcher, Nev.	Oct. 30	Nov. 24	0.02
Sierra Nevada, Nev.	Oct. 12	Nov. 2	0.10
Silver Pick, Nev.	Sept. 25	Oct. 30	0.01
Smuggler, Utah	Sept. 20	Oct. 18	0.005
Spearhead, Nev.	Oct. 2	Nov. 2	0.01
Tarbox, Mont.	Sept. 28	Oct. 28	0.005
Tonopah-Bonanza, Nev.	Sept. 19	Oct. 16	0.01
Tobar, Utah	Nov. 2	Nov. 23	0.002
Umatilla, Nev.	Sept. 18	Oct. 24	0.0025
Uvada, Nev.	Oct. 9	Oct. 26	0.02
Diamondfield Bl'k B'tte, Nev.	Oct. 12	Nov. 18	0.01

Editorial Correspondence

JACKSON, CALIF.—Oct. 10
(By Telegraph)

Union Posted Warning on Monday for all men, except superintendents, book-keepers and foremen, to keep away from the mines during the strike. Two agitators have been arrested. The South Eureka mine attempted work today but 250 strikers prevented reopening. District Attorney Snyder warned the men that they were breaking the law. There is great excitement in camp and fears are entertained of a general outbreak.

SAN FRANCISCO—Oct. 4

Keeler Is Dry since the recent cleanup and now it is commonly asked what excuse the town has for continuing to encumber the earth. It needs no excuse for being the supply point or the shipping point for a territory, reaching back into the hills and including Darwin, Ophir, Cerro Gordo, Saline Valley and numerous small mining and prospecting camps. Through Keeler were shipped approximately 460 carloads of mineral products in September. These carloads, averaging 10 tons to the narrow-gage car, were made up of 161 cars of ore, 144 of slag, 6 of talc, 56 of rock, 90 of soda ash. That makes a total of 457 in 29 days of September. While the Cerro Gordo is the largest shipper through Keeler, it is by no means the only shipping mine in the Owens Lake region. The Estelle mine opened by the Troeger tunnel and numerous small mines in the neighborhood, and the Santa Rosa have joined the narrow-gage-car procession. The Lucky Jim has not quit altogether, since the installation of a flotation plant at the mine, and all the supplies for this and other mines and the camp of Darwin are obtained at or shipped through Keeler. The Saline Valley Salt Co. is moving 200 tons of salt a day over the 13-mi. aërial tramway and shipping as fast as cars can be obtained from the Swansea switch. The soda ash going out is part of the soda-products recovery from Owens Lake by the Inyo Development Co. and the Natural Soda Products Co. The reason shippers fail to do better is that the car supply is short. This hasty assembling of a few facts reveals why Keeler remains on the map. The shipments go chiefly eastward to Salt Lake, though San Francisco gets a portion, and should get more. At present the San Francisco shipments are chiefly by way of Hazen or Reno, Nev. The building of a connecting railroad from Keeler along the east shore of Owens Lake to Olancha, a distance of 20 mi. would turn the tide of shipments from Owens Lake region via Mojave to San Francisco and Los Angeles, and the large amount of supplies coming in from those points would be doubled, and be an advantage to the entire region.

Production of Crude Oil in California fields in August totaled 8,079,023 bbl., a daily average of 185 bbl. less than in July. Shipments in August reached a new high mark, totaling 9,548,075 bbl. or an excess over production of 1,469,052 bbl. Daily average shipments in the first half of 1916 were 267,235. Stocks on hand at Sept. 1 totaled 49,311,395 bbl. as against 50,780,447 on Aug. 1. Field reports show 51 wells completed, 62 new rigs, 284 wells drilling, 6,696 wells producing, 8 wells abandoned. This shows a decrease of nine completed wells and an increase in all other items, the producing wells increasing 71 over July.

BUTTE—Oct. 5

September Payroll of the five largest mining companies operating in Butte district distributed $2,189,000 in wages for September. Anaconda's roll for September was $1,560,000—$70,000 less than for August. The Butte & Superior September roll was $256,000 while that of the Clark properties, including the Elm Orlu mine and Timber Butte mill, was $70,000 and that of East Butte $137,000. Miners received the maximum scale in September, $4.50 per day, because of the high price of copper.

The Du Pont Powder Company's Plant situated between Butte and Anaconda, about 10 mi. west of Butte, is rapidly nearing completion. A large crew of men has for months been on the ground, engaged in constructing the various buildings required in the manufacture of explosives, as well as in the construction of roads, fences, railroad tracks and other facilities for handling the finished product. The welfare of the employees of the plant has not been lost sight of, and a dozen or more substantial cottages, equipped with every modern convenience are in process of construction. The settlement and the station on the Butte Anaconda & Pacific Ry. will be known as Ramsey, named after Colonel Ramsey who died recently after a long career with the du Pont company.

Butte Main Range First Shipment of high-grade copper ore was made recently when 40 tons taken out in the development work on the 500-ft. level was loaded and sent to the Washoe smeltery. This ore came from the Sinbad vein and is merely the ore taken out there in the cleaning-up work. Paul A. Gow, general manager of the company, said "The Tropic, of the Anaconda company which adjoins this property, has been producing splendid ore from the levels between the 500 and 700, and we feel confident that we will develop commercial ore that we can begin shipping from the same levels within a short time."

Butte & Superior Mine and Mill output for the month of September was approximately 50,000 tons of ore from which were produced about 4,000 lb. of concentrates. From this about 15,000,000 lb. of zinc in concentrates was secured. The percentage of recoveries ran from 93½ to 94%. About 290,000 oz. silver in concentrates was secured. Butte & Superior improvements are progressing and by the first of the year it is expected that the new shafts will both be completed, equipped and put into operation. The headframe at the new main shaft is completed and is the highest headframe in the Butte district. Its height is 152 ft. over all and from the collar of the shaft to the center of the sheave wheel is 135 ft. The belt conveyor from the coarse-crushing plant at the ore bins to the mill, has been completed and is now in operation. The foundations for the hoist and the new hoist buildings are all in and the steel work is going up. The new change house with accommodations for 1,800 men is nearly finished and will be put into service within three weeks. It is one of the best equipped in the district. In the new main shaft most of the stations and skip pockets down to the 1,500-ft. level are complete and connections have been made with the new No. 2 timber shaft. Most of the stations of this shaft are also completed.

DENVER—Oct. 4

The Denver & Rio Grande R.R. was an important factor in the upbuilding of numerous mining camps in Colorado. Its original lines were all of narrow gage. By a gradual process, the main line and several important branches have been made standard gage. For a long time, the main lines were three-rail tracks but it has been the desire of the company to entirely do away with traffic in both narrow- and standard-gage rolling stock over the same lines and, as a consequence, the third rail was taken up between Denver and Salida and between Pueblo and Alamosa. It is impossible to send narrow-gage carloads of ore to the big smelteries in Denver and Pueblo, and this is an item of significance to such districts as Ouray, Telluride, Lake City, Silverton, Gunnison, Rico and Pitkin. Some time ago (since the establishment of the state public utilities commission) the railroad company applied to the state authorities for permission to take up the third rail between Salida and Leadville; but there was such a protest awakened among ore shippers in Leadville and Breckenridge as well as throughout the San Juan country that the commission refused the request. By retaining the third rail in this stretch of main line, narrow-gage cars can be shipped to the smeltery of the Ohio & Colorado Company at Salida from portions of western Colorado that are provided only with the narrow lines.

General Mining Revival in Colorado is evidenced by the number of new companies incorporated since the first of present year, a total of 350. It is estimated that the 1916 output of all metal mines will exceed that of 1915 by 25%. Another indication of mining prosperity is the great increase in bank deposits in some of the mining counties, Boulder, Lake, Teller and San Juan being the most notable in this respect. Boulder County has furnished the only real sensational boom, this due to the high price of tungsten in the fore part of the year. Leadville district, it is estimated, will make a greater total production than Cripple Creek for the first time in years, and this will not be due to any falling off in Cripple Creek's production. Many old properties in San Juan County have been reopened and at least one important tungsten mine developed. In Summit County the Breckenridge district has taken on new life. Dredges are producing more than ever and new ground is being constantly drilled. New companies have been organized, old mines reopened and new mills built and in the case of the Wellington, additional property acquired, and capacity of milling plant increased. Robinson, formerly a dead camp in Summit County, now has several mines operating. Park County is also taking on more life with new milling plants operating at old mines and some hydraulic work. In San Miguel County, the milling of Black Bear ore at the Smuggler-Union plants is adding largely to the production. In several other counties notably Gunnison, Hinsdale and Saguache, new and old properties are being opened.

SALT LAKE CITY—Oct. 6

Utah Copper's Production for the third quarter will be more than 60,000,000 lb., and earnings in the neighborhood of $11,000,000—not including interest in the Nevada Consolidated. The present rate of production is in the neighborhood of 20,000,000 lb. copper per month. With the interest in the Nevada Consolidated included, earnings for the quarter will be in the neighborhood of $1,000,000 a week.

Hearing in the Smoke Suits brought by farmers against the American Smelting and Refining Co. and the United States Smelting Co. was resumed Oct. 4 in the United States court before Judge Tillman D. Johnson. The cases have been on trial since last spring, but recess was taken during the summer. The plaintiffs have presented their side, and evidence is being offered by the smelting companies to show actual conditions. Both smelting companies have experimental farms in the neighborhood of the smelteries, where extensive data has been gathered. In this connection it may be mentioned that the United States company has received an unusual number of awards at the Utah state fair, now in progress, on stock, vegetables, grain, etc., raised on its farm.

Tintic Standard and Emma Copper are two Utah mines at present attracting attention, the former of east Tintic, and the latter of Alta. A recent strike at the Tintic Standard promises another regular producer. The company has been operating for a number of years and has made shipments from time to time. The orebody recently opened—lead-silver ore of shipping grade—is on the 1,600 level and up to the present has been developed 75 ft. by 60 ft. by 7 ft., with sides, roof and floor still in ore. In all about 10 cars of ore have been shipped from the strike, the ore having brought from $1,500 to $2,100 a car. The Emma Copper, which has been prospecting by diamond drilling in conjunction with the old Emma Leasing Co., has reported through its managing director, C. S. Herzig, that three drill holes have cut ore. Some of the cores show galena and some argentite. The drills were in ore 14 ft. and more in thickness. This prospecting was undertaken in hopes of finding the continuation of the old Emma orebody, which was cut off by a fault. The strike is of interest, although it may be some time before its full importance is determined. To reach this ore an inclined winze, or an old vertical working shaft from the Bay City tunnel will be unwatered, after which about 200 ft. of drifting or crosscutting will be done to reach the ore. Whether this is a continuation of the faulted Emma orebody, productive in early days, or some other orebody, remains to be seen. The position of the ore does not exclude the former possibility, and if this should prove the case, the displacement will be proved to be between 350 and 400 ft.

DULUTH, MINN.—Oct. 5

Royalties of $9,000 Per Day are being received by the State of Minnesota at present from state-leased mines. Fifteen state mines are being operated and the weekly output is in excess of 215,000 tons.

Soo Line Ry. Officials announce that the Soo ore dock at Superior, Wis., will have an extension of 600 ft. added, giving 50 additional pockets. This dock handles Cuyuna Range ore exclusively, as the Soo Line hauls no Mesabi Range ore.

Chisholm District Has 570,000 Tons yet to be shipped. The Oliver has 200,000 tons, while the Great Northern has 200,000 and the Shenango 170,000. The manager of the Great Northern properties has received orders to keep shipping "until the boats freeze in the lakes." The Shenango will stop shipping on Nov. 7 and begin stockpiling. About 1,000 men are employed underground at the present time. Labor is plentiful in the Chisholm district at present. The force will be increased to 1,500 men during the winter months.

Iron Ore Shipments from Lake Superior district for September reached 9,600,786 tons, making a total of 48,816,650 tons to Oct. 1, an increase of 14,147,084 tons over same period of 1915. The October movement should reach 8,500,000 tons and some ore will be moved in November and December. The total for the season should be near the 62,000,000-ton mark. The shipments by ports in September follow: Escanaba, 922,517; Marquette, 557.140; Ashland, 1,255,328; Superior, 1,945,171; Duluth, 3,455,611; Two Harbors, 1,456.019.

JOPLIN, MO.—Oct. 7

Extension of the Zinc Fields to the North is the hope of a new company just organized to drill near Columbus, Kan. Thirty-five business men of Columbus constitute the company and have pledged themselves to put in $20 a month, each, for one year, to pay for prospecting. It is purely a civic movement—something new for this part of the country.

Three Thousand Tons of Surplus Ore in the Oklahoma field is the estimate of the editor of the "Commerce News," who made a trip over that district last week. This is likely too low, but is interesting as some have guessed the surplus in the Oklahoma section of the district to be as high as 17,000 tons. Probably 5,000 or 6,000 tons would be nearer correct.

Sheet Ground Mines of West Joplin are starting up despite the fact that there have been no rains. The A. W. C. Co., which has four mills in this section that have been idle since early in July, has obtained water from its drifts to fill its ponds and the management believes the decreased evaporation since the passing of extremely hot weather will make it possible to keep going. The La Nora B mine also has started up again, but the Ramage is still down and likely to remain so for some time.

EL PASO, TEX.—Oct. 6

Mine Titleholders in Mexico must work their mines or forfeit their titles, according to a decree signed by Carranza on Sept. 14, which became a law on date of publication. The Department of Fomento will declare the forfeiture of any mine that is idle for two consecutive months, or is idle at various times for a total of three months in one year, and will notify the Department of Finance, which will decide whether the mine shall again be denounced or worked by the government. The Department of Fomento will also fix the minimum number of laborers to be employed in developing new mining claims, but will allow the producing mines to resume operations with not less than the number of men working at the time work was suspended. If it is impossible to work a mine, however, the manager must present evidence of the fact to the department, which may permit the suspension of operations for three months. Mine titleholders must also, under penalty of forfeiture without recourse, keep all taxes paid up quarterly, notwithstanding the fact that it may have been impossible for the owner to keep in physical possession of the mine or operate it. A mine-tax law of June 6, 1892, was cited.

TORONTO—Oct. 7

The Ontario Nickel Commission, which recently visited Sudbury and other mining districts in northern Ontario, is now finishing its work here. Dr. Willet G. Miller, who recently returned from a lengthened examination of the nickel field of New Caledonia, states that he found the nickel deposits there to be of considerably greater extent than is generally supposed. Large ore-bearing areas have not yet been developed. Some highly valuable deposits are owned by the International Nickel Co. and held as a reserve. The commissioners are reticent as to the findings of their forthcoming report, but the general impression in political circles is that it will strongly urge the refining of nickel in Canada under some form of strict government control.

The Report of the Royal Commission, appointed Aug. 28, to investigate the nature and causes of unrest in the mining industry of Cobalt, has been issued. During the sittings of the commission, a total of 79 witnesses were examined on behalf of the miners, and eight on behalf of the operators. There were only two demands, one being for increased wages and the other that the employers recognize and confer with a committee of the men. The commission reported that as far as all the other conditions of working the mines are concerned, the employees were unanimous in expressing their satisfaction. The report deals separately with the two points at issue. The question of increased wages was urged strongly by the men and was based on the increased cost of living. This increase was stated by various witnesses to range all the way from 20 to 40%. The employers admitted the increased cost of living but claimed from figures gathered by them from the reports of the labor department, that the increase in the last two or three years averaged only about 10%. On May 1 the managers granted an increase of 25c. a day to practically all employees, and believing that silver was destined for some time to come to sell over 70c. an ounce, granted a bonus to underground workers of 25c. a day when silver averaged 70c. or over for the preceding month. This bonus, due to the drop in the price of silver, was paid for only two months. The managers claimed that the 25c. increase was sufficient to offset the increased cost of living, and further that the conditions under which the mines were being operated at present did not justify them in granting any further increase. The increased cost of living was acknowledged by all parties, only the percentage of increase being in dispute, and the commission in view of the conflicting evidence found it difficult to determine exactly what the percentage of increase might be. The commissioners concluded, after reviewing all the evidence that they were not prepared at present to recommend an increase in the rate of wages, but they confirmed what the managers had already done including the bonus, but stated that in their opinion the bonus should be based on silver at 65c. an oz. instead of at 70c. The other grievance related to the refusal of the mine managers to meet the committee, composed of union men, appointed for the purpose of interviewing them in regard to wages. The employers in giving evidence stated that while they had no objection to meeting their own men, and believed in the miners having an organization, they considered the committee as representatives of the Western Federation of Miners, and they refused to have anything to do with that organization. The commissioners reported that as the committee was composed of local men, that there was evidently some misunderstanding as to the nature and scope of this committee, and that it would have been better for the managers to have conferred with the committee. This report is signed by two of the commissioners, while a minority report, was as perhaps might have been expected, presented by the third commissioner, who was the labor delegate. The minority report states definitely that on account of the increased cost of living all employees should have received a straight increase of 50c. a day. There is no obligation on the managers to follow the recommendations of the report, and it is not known whether there is any possibility of the men getting further concessions. In view of the fact, however, that wages in Cobalt are on a par with the highest paid in any camp in the province it is doubtful if any material changes in the present scale will be made.

The Mining News

ALASKA

ALASKA MEXICAN (Treadwell)—Returns for August show running time of mill 20 days, 7 hr.; tons of ore crushed, 13,160 tons; concentrates saved, 346.53; estimated value of free gold, $15,959; of concentrates, $14,579; estimated realizable value, $30,232. With operating expenses of $16,461, and construction expenses $4,606, the estimated net profit was $9,165; other income, $3,730. Yield per ton of ore milled was $2.32; stock of broken ore decreased by 9,842 tons.

ALASKA UNITED (Treadwell)—Returns for August: Mill ran 30 days 13 hr.; tons of ore crushed, 49,889; estimated value of free gold, $51,527; of concentrates, $52,373; estimated realizable value, $102,861. Estimated profit on Ready Bullion mill, $19,940; loss on 700 Claim mill, $5,322. With construction expenses on the Ready Bullion of $7,925, and on the 700 Claim of $6,559, the estimated total loss on the latter of $11,882 nearly balanced the profit on the former of $12,015.

ALASKA TREADWELL (Treadwell)—August report gives subsidence of hanging wall, due to drawing of reserves, reason for shutting down 240 mill and one-half of 300 mill on Aug. 1. Time run by 240 mill only 10 hr., and by 300 mill, 30 days, 16 hr. Tons of ore crushed, 24,696; tons concentrates saved, 784; estimated gross value of free gold, $11,825; of concentrate, $63,582; of base bullion, $2,787; of total production, $78,195; of realizable value, $77,413. Operating expenses were $44,416, giving estimated operating profit of $32,997. With construction expenses at $17,585, estimated net profit was $15,411. Yield per ton was $3.16; stock of broken ore decreased by 5,411 tons.

ARIZONA

Cochise County

SHATTUCK-ARIZONA (Bisbee) — September production: Copper, 1,566,446 lb.; lead, 233,800 lb.; silver, 26,928 oz.; gold, 419 oz. Nine months' copper production, 13,543,030 lb.

Gila County

INSPIRATION NEEDLES (Miami)—Planning to sink 300-ft. winze from tunnel on Standard No. 5 claim to open up 100-ft. mineralized dike traversing property.

INSPIRATION CONSOLIDATED COPPER (Miami) — September production, 11,850,000 lb.; August, 11,450,000 lb. Reported that plans are being prepared for leaching plant.

MIAMI COPPER (Miami)—Injunction obtained at Wilmington, Del., by Minerals Separation, Ltd., stayed pending hearing in Circuit Court of Appeals, provided monthly statement of flotation operations be filed. Total September copper production about 4,381,000 lb.

Greenlee County

ARIZONA COPPER (Morenci)—A 10-in. pipe line for air being installed on 2nd level; recent fire in Clay mine extinguished.

SHANNON COPPER (Clifton)—September production, 774,000 lb.; treated low-grade ore; also 5 days required for furnace repairs. August output, 860,000 lb. Company resumed dividends posting 25c. quarterly and 25c. extra, payable Nov. 15.

DETROIT COPPER (Morenci)—Tunnel connecting West Yankee shaft with orebodies explored by churn drills in Coronado Hill struck orebody now being tested by churn drills.

Maricopa County

GOLD BAR MINES CO. (Wickenburg)—New company, backed by Pittsburgh capital, to reopen old O'Brien mine, near Wickenburg. Now equipped with good buildings and 12-stamp Nissen mill. Mill will not be started until new shaft is sunk to 600-ft. level. Active development has begun. T. H. Jenks, manager.

Mohave County

OATMAN SYNDICATE (Oatman)—Development resumed by prospecting along vein.

CUSTOM MILL at Chloride may be constructed under management of Frank Steffee. Process will include flotation.

TOM REED (Oatman)—Red Cloud shaft crosscut penetrated 9 ft. of vein, 115 ft. from shaft, and footwall not yet reached.

GOLD DUST (Oatman)—On second level, 800 ft. northwest of shaft, a 30-ft. winze penetrated 14-ft. orebody. Engineer estimates 50,000 tons ore blocked out in property.

OATMAN UNITED (Oatman) — Property financed and shaft sinking being pushed to reach 600-ft. level. A 60-hp. compressor en route from Kingman will soon allow use of air drills.

Yavapai County

NEW STATE (Prescott)—Struck 18-in. vein, assaying high in gold.

EWING & HOOKER (Jerome)—Has opened gold ore in 260-ft. tunnel.

HARRY HAUSEN GROUP (Jerome)—F. M. Winter, of Phoenix, has taken over and will develop.

PITTSBURG-JEROME (Jerome) — Southwest crosscut penetrated 12 ft. copper ore. S. S. Ballard, manager.

VERDE MONSTER (Jerome)—New promotion of Charles P. Myers, of Los Angeles, to develop Black Warrior group, 8 mi. north of Jerome.

ALVARADO GROUP (Congress)—Has been taken over by New York men; extensive development planned, including new reduction plant.

UNITED VERDE EXTENSION (Jerome)—Reported to have recently secured smeltery site. Shipping 8,000 to 8,500 tons high-grade ore monthly.

JEROME DAISY COPPER (Jerome)—New organization of Phoenix, Bisbee and Prescott men to take over 10 claims situated north of the Arkansas and Arizona.

ARKANSAS & ARIZONA (Jerome)—At recent meeting, John Boyle elected president; H. N. Jasper, secretary-treasurer; H. P. Tear, vice-president; W. D. Tickner, director, all of New York. Stock has been listed on Curb.

CALIFORNIA

Amador County

KENNEDY (Jackson)—The mine's first-aid team, which won first prize—the silver trophy cup at the recent meet at Sacramento—received in addition $10 each from E. C. Hutchinson, president of the Kennedy Mining and Milling Co. The team is composed of G. Ireland, William Daugherty, H. Stewart, A. Rossi, U. Gianfardoni, J. Hill, J. Canonica. In addition to these prizes the California Metal Producers' Association paid a cash prize of $30 to the team and a gold medal to each member. The Argonaut team, which won first prize at the Panama-Pacific meet a year ago, was third this year, and though much disappointed, is drilling hard for next contest.

Inyo County

SODA ASH, recovered from Owens Lake, shipped on Southern Pacific in September, amounted to nearly 1,000 tons. Total mineral shipments from Keeler in September totaled approximately 460 carloads of 10 tons per car.

LUCKY JIM (Darwin)—New flotation plant said to be in successful operation. Mine supplies are hauled in by motor truck from Keeler, distance 25 mi.

CERRO GORDO (Keeler)—Shipped in September about 1,000 tons of zinc ore and 250 tons lead ore; 144 carloads of slag added to the month's shipments made a total of 269 narrow-gage cars.

ESTELLE (Keeler)—Drifting on first of five veins cut by the 7,000-ft. Troeger tunnel; high-grade silver-lead ore recently opened. Property south of old Union mine; ores contain silver, lead, copper, gold and zinc. Roy C. Troeger, superintendent.

TUNGSTEN MINES (Bishop)—Shaft completed in August on Little Sister, connecting surface with lower tunnel, now used as chute for ore from surface gloryhole. Large surface deposit will be quarried into shaft and trammed through tunnel and on surface track by electric motor to mill. New Deister table added to four concentrators of mill equipment, which will be increased to a total of 12 tables, including Deister, Isbell and Wilfley types. Concentrator house 30x100 ft. will be added to the mill building.

Tuolumne County

DRILLING CONTEST at Jamestown on Labor Day won by Payton and Burbank, of Amador, drilling $30^{12}/_{16}$ in. in 15 min. Lumsden brothers, of Big Oak Flat, drilled $30^{11}/_{16}$ in. in the same time. In mucking contest, E. Costella shoveled one ton of rock in 3¾ min. Earl Barron shoveled one ton in 3 min.

BUCKEYE (Sonora)—Miners to whom wages were overdue have received 50% with promise of the remainder within 60 days. Reported property will be reopened by New York men.

STREET (Tuttletown)—Headframe, hoist building and compressor building recently destroyed by fire, which also burned timbers in shaft to depth of 60 ft. Reported that mine will be unwatered, equipment rebuilt and operation resumed. Richard Kinsman, of Oakland, owner.

COLORADO

Boulder County

KEYSTONE MINING AND REDUCTION (Boulder)—Building 50-ton mill.

LIVINGSTON (Sugarloaf)—Latest cleanup at milling plant brings present production for year up to $50,000.

NELSON MINE (Ward)—Operated by crew of three, made production of 6½ tons tungsten concentrates during month of September.

Clear Creek County

TEK MINING, MILLING AND LEASING (Idaho Springs)—Shoot of bold-silver-copper ore opened in main tunnel level while driving to cut cross vein. Tunnel will be advanced 500 ft. farther to cut second cross vein. Mine equipped with 10-stamp mill, modern mine plant and hydraulic power plant.

Lake County

WESTERN ZINC OXIDE (Leadville)—Construction of four furnaces completed recently.

LEADVILLE UNIT (Leadville)—U. S. S., R. & M. Exploration Co., will retimber the 525-ft. Jamie Lee shaft. Intend to sink 300 or 400 ft. into the white limestone, where approximately 2,000 ft. of exploratory work is contemplated. Will install double-drum electric hoist, with capacity of 5,000 lb. at rope speed of 400 ft. per min. H. S. Lee, manager.

La Plata County

VALLEY VIEW (La Plata)—Flotation process being installed in new milling plant. Several strikes of high-grade gold-silver ore reported made in district lately.

Ouray County

REVENUE (Sneffels)—Property acquired by St. John Mining Co.

JUMBO (Ironton)—Car gold-silver-lead ore shipped recently by lessees netted $60 per ton.

CAMP BIRD (Ouray)—New tunnel now in 2,085 ft. Will be driven total distance of 10,700 ft.

MOUNT HAYDEN (Ouray)—Milling-grade oreshoot 3 ft. wide opened in development work.

GOVERNOR (Ouray)—Shoot of high-grade gold quartz several inches wide opened in this Sneffels mine. Talc streak beside quartz also high grade.

CROWN PRINCE MINING (Ouray)—Reorganized and money raised to complete milling plant. Property just below town of Ouray and mill on railroad.

ST. PAUL (Ironton)—New oreshoot 18 ft. in diameter opened in this Red Mountain property. Ore occurs in chimneys and chief value is in copper and silver contents. Last shipments netted $800 per car. Crew of 18 men employed.

MOUNTAIN TOP (Ouray)—Machinery for new mill received. Plant will be unique in milling practice as it will be built underground 900 ft. from tunnel portal. This will permit winter work without interference from deep snows and snow slides. Large tonnage milling-grade ore developed.

SUMMIT COPPER MINING AND MILLING (Ironton)—Development commenced in Koehler tunnel to open San Antonio property at Red Mountain. Force of 10 men repairing tunnel and placing underground equipment in condition. John F. Roper, manager.

Park County

BLACK CLOUD (Alma)—Four-foot vein assaying well in gold, silver and lead opened recently. Preparations for winter work under way. Property near London mine.

San Juan County

FRANK WALLER (Animas Forks)—Lessees Hayti & Boss have opened 3-ft. vein, assaying 0.5 oz. gold and 70 oz. silver a ton.

GREEN MOUNTAIN (Silverton)—A. W. Harrison and associates have obtained options on Pride of West and Green Mountain mines, and will treat ores in Green Mountain mill, which is being overhauled and repaired.

Summit County

BLUE FLAG (Breckenridge)—Stated company will resume operations on its Colorado properties at Breckenridge and Cripple Creek.

PIONEER CONSOLIDATED (Breckenridge)—New tunnel being driven and old workings repaired. Mill will be running to capacity soon.

EL DORADO (Breckenridge)—Crosscut tunnel being driven to cut vein at depth. Mine equipped with compressor, machine drills and milling plant.

COLORADO METALS (Silverton)—Car high-grade tungsten concentrates shipped recently to New York City. Ore produced from Dawn of Day mine and treated at Yukon mill. Louis Schafer, manager.

WILFLEY (Kokomo)—Carload of zinc sulphide ore shipped to new mill of Colorado Metals Separation Co., at Breckenridge. If tests are successful, large tonnage of similar ore will be shipped from this and other mines in Kokomo district.

NEW PLACER MINE in Breckenridge—portions of Washington and Pittsburgh ground—has been leased by Denver men and hydraulic equipment will be installed. Survey now under way for pipe line from Indiana Gulch, a distance of seven miles.

MUTUAL CORPORATION (Kokomo)—Vein 10 ft. wide with 1-ft. shoot, assaying 40 oz. silver, opened in this Jacque Hill property. Ore also assays well in gold and lead. Crosscut tunnel, now in 330 ft., being driven to cut Gold Queen vein at depth of 250 ft.

TONOPAH PLACERS CO. (Breckenridge)—Testing area south of Gold Pan placer. New dredge, larger than those now operating, may be built for this ground. No. 3 dredge recently cut through apex of large silver-lead vein; thought to be extension of vein on New York group.

PUZZLE LEASING CO. (Breckenridge)—New machinery to be installed at shaft and sinking to 500-ft. level started at once. In level from this shaft below tunnel level 1,000 ft. of new development work opened shoots of good-grade lead and zinc ore assaying well in gold and silver. After an examination by Forbes Rickard, it is stated, Bulkley Wells, manager of Smuggler-Union Mining Co., Telluride, Colo., has become intersted and has assumed management.

Teller County

PORTLAND (Cripple Crek)—Oreshoot 500 ft. long, 10 to 40 ft. wide, with fair gold content, reported opened on lowest or 1,950-ft. level recently.

GRANITE (Cripple Creek)—Rich oreshoot opened on 1,400-ft. level. Another shoot discovered on 1,500-ft. level of Bobtail vein, which extends into Portland territory.

DELAWARE

WORTH BROS., who sold their Coatesville, Penn., plate mills to Midvale Steel and Ordnance Co. about a year ago, will build $10,000,000 plant on Delaware River, 6 mi. below Marcus Hook and 8 mi. above Wilmington.

IDAHO

Shoshone County

EMPIRE COPPER (Enaville)—Mill capacity to be increased from 150 to 300 tons daily. Machinery already ordered. Now shipping three cars concentrates weekly to Trail smeltery, which averages 18.5% copper. Company employs about 60 men.

RAY-JEFFERSON (Wallace)—Will be greatly benefitted by new branch of O. W. R. & N. R. R. started building up Beaver Creek. Test runs made with new 400-ton mill reported satisfactory. Pending railway completion shipments will be made by motor trucks.

BUNKER HILL & SULLIVAN (Kellogg)—Grading for smeltery buildings completed and concrete foundations in place. O. W. R & N. R.R. is installing sidings from main line at Sweeny. Active building construction begins soon with delivery of materials from storage at Kellogg.

HECLA (Burke)—Milling 450 tons daily at Gem mill and 300 tons at Federal mill. When 200-ton addition to its own mill is completed, Federal plant will probably be retained. Gross income for six months ended June 30, 1916, was $1,082,587, on which net profit was $766,887, or $205,135 more than for entire year of 1915.

MICHIGAN

Copper

1916 COPPER PRODUCTION for Lake Superior district, according to local estimates, will reach 280,000,000 lb., scarcity of labor preventing greater production.

ALLOUEZ (Allouez)—Shipping more than 2,000 tons daily.

ISLE ROYALE (Houghton)—Average grade of rock now better than 14 lb.

AHMEEK (Ahmeek)—Developing second fissure vein which miners claim will prove as good as first developed by No. 2 shaft.

CALUMET & HECLA (Calumet)—Considerable 50-lb. copper rock recently sent to stamps from lateral extensions into territory previously regarded of doubtful value. Flotation process plans under consideration.

Iron

ON MARQUETTE RANGE annual report of Inspector of Mines for year ended Sept. 30, shows 13 men killed—the best showing of any year for some time past. There are 116 mines, of which only 33 are in operation. Men employed underground, 3,332; on surface, 1,578. Number of fatal accidents per 1,000 men employed was 2.58.

CASTLE (Wakefield)—Shaft sunk to 19th level. Pump station now being cut. Two 500-gal. electric pumps to be installed.

TRADERS (Iron Mountain)—Stripping about completed. Contract let first for removal of 50,000 cu.yd., later increased to 100,000 cu.yd. Ore will be shipped until close of navigation.

SECTION 16 (Ishpeming)—New engine house about completed. Hoist already installed. Four 4-ton electric locomotives to be put underground on two main levels and two 2-ton locomotives on surface trestles. New steam engine and a 100-kw. generator installed. All electric wiring completed.

MISSOURI

Joplin District

HURRY UP (Webb City)—Enlarged its Portia plant at Galena and restarted operations after three weeks' shutdown.

J. B. S. (Joplin)—Getting good "chunk lead" in shallow ground, 56 ft., on Aylor land, 4 mi. east of Joplin. New field.

TWO-FORTY (Picher, Okla.)—Started drilling on 240-acre tract directly east and adjoining Picher Lead Co. developments.

F. R. COOK (Springfield)—Paid $60,000 for lease on 1,115 acres of mineral land 4 mi. north of Commerce, Okla., and will develop.

TULSA (Joplin)—Building mill on Haggerty tract in South Joplin. Working good run at 95 ft. but main body lies at 165 ft.

McDONALD (Webb City)—Have sunk shaft through 35 ft. of rich, soft ground ore and will be drifting soon. Property is close to former big soft-ground producers.

OSAGE (Carthage)—Encountered ore in new shaft at 184 ft. Company headed by Dr. Charles Powers, pastor, First Methodist Episcopal Church, South, at Springfield.

LUCKY STAR (Joplin)—Opened up rich run of blende in mine, in which Ohio capitalists sunk considerable money in 1909. Former company was working just over ore.

BALTIC (Duenweg)—Former rich producer, virtually worked out, leased to miners for pillar pulling. Was sold for $125,000 in July, 1915, and company made big profits over cost.

FIFTH STREET (Joplin)—Opening up good mine on Starr land. Plan joining with C. M. & H. Co. in erection of mill, latter company to work Glendale shaft on Continental land.

EVANS-HALL-SOY (Duenweg)—In driving air drift opened face of rich ore 8 ft. high, 45 ft. wide, in sheet ground at 215-ft. level. May be extension of O. F. & L. run, short distance southeast.

BARNETT-GROUNDS (Duenweg)—Constructing 200-ton calamine mill on Burch land. Mill will cost $25,000 and $14,000 already spent in development. Will be most pretentious calamine property in district, Granby excluded.

FREEMAN-BARNETT (Duenweg)—Good shallow lead ground opened, making output of 100 tons in week. In another shaft on lease the company now sinking in sheet-ground blende ore, which will be worked after lead is exhausted.

W. M. SHERIDAN (Picher, Okla.)—Has let contract for 300-ton mill, to be erected on developed tract west of Picher. Company had long fight with water, but now has two shafts in good ore. Mill to be completed in 90 days.

COAHUILA LEAD AND ZINC (Webb City, Mo.)—Overhauling mill No. 1 at Porto Rico and installing new jigs, bringing capacity up to 900 tons per day by Nov. 1. Tramway from field shaft to Carthage mill is completed; about 500 tons per day will be handled.

MONTANA

Beaverhead County

BEAVERHEAD-ALBERTA CO. (Dillon)—Drilling for oil 9 mi. south near mouth of Smallhorn Cañon. Now down 500 ft.

Carbon County

MONTANA COAL AND IRON CO. (Washoe)—Coal mine in Bear Creek district compelled to suspend for several weeks; fire destroyed tipple, Sept. 24.

Granite County

GRANITE BI-METALLIC (Philipsburg)—J. P. Meyer, of St. Louis, elected president of company to succeed L. M. Rumsey, Jr., who retired from management on account of illness. Company's mines near Philipsburg, large producers of rich silver ore in past, are still in the list of regular producers. Extensive new development being carried out at mines to open up new ore reserves.

Mineral County

INTERMOUNTAIN COPPER (Superior)—The 100-ton mill is in operation. Reported more than three years' ore supply developed in old Amador mine. Edward Evans and Oscar Nordquist were recently elected president and general manager respectively.

Silver Bow County

EAST BUTTE (Butte)—Plans to explore properties down to 2,200 level. So far in 1916 company has produced 12,043,860 lb. of copper.

BUTTE-DULUTH (Butte)—Plant expected ready by Oct. 15 for operation, and leasing company plans mining 500 tons per day by end of year.

BUTTE & SUPERIOR (Butte)—Owing to necessary repairs to old shaft during August, output of zinc in concentrates fell from normal 16,000,000 to 10,000,000 lb. Conditions again normal. With new shafts completed in a few months shutdowns due to shaft troubles will cease.

BUTTE & GREAT FALLS (Butte)—Exploration work by diamond drills on Rio Tinto and Snowdrift claims recently acquired. Will drill to depth of 1,000 to 2,000 ft. Veins intercepted in crosscut on 500 level show zinc and lead. Water encountered in Dewey vein on that level now being handled without difficulty.

ANACONDA (Butte)—Lexington mine, for some time developed by Anaconda for zinc ores, will be sold at auction in Butte on Nov. 1. Sale a formal step in final disposition of assets and cash distribution to stockholders of Atlantic Mines Co., former owner. Anaconda offered price for property, which will return to stockholders $250,000 cash originally in treasury.

TUOLUMNE (Butte)—Development work in eastern section district making rapid progress. Within 30 days regular shipments of ore will probably be made from properties, including Butte-Main Range and Colusa-Leonard Extension. At latter mine, new hoist being installed after which unwatering will begin. At Main Range, crosscut on 700 level will be carried 1,200 ft. to south side line, where Anaconda company's adjoining Tropic mine is producing ore from stopes betwen 500 and 700 levels.

NEVADA

Esmeralda County

CRACKER JACK (Goldfield)—Shaft being retimbered to 320-ft. level where laterals will be driven to pick up extension of oreshoot encountered on 120-ft. level.

SILVER PICK (Goldfield)—Shaft down about 940 ft.; will be continued to shale-alaskite contact. At this point a west crosscut will be driven to develop veins disclosed by recent core drilling west of shaft.

GOLDFIELD CONSOLIDATED (Goldfield)—Final report for August shows net realization of $18,211.10 from treatment of 17,300 tons. Decreased tonnage result of delays incidental to conversion of plant to flotation treatment. Total operating costs $7.04 per ton; 1,664 ft. of development done at $8.39 per ft.

GREAT BEND (Goldfield)—East drift on 300-ft. level, incline, penetrated 50 ft. in second ore shoot, yielding assays from a few ounces to 20 oz. gold across a width from 1 to 3 ft. Recent carload shipment assayed about $40 per ton. East drift out 150 ft., showing 2½ ft. shipping ore. West drift penetrated fault. Jack Campbell, superintendent.

Humboldt County

PACKARD NORTH EXTENSION (Lovelock)—Development by company discontinued; lease given to Kromer & Hogerton.

ROCHESTER MINES (Rochester)—Plans to erect aerial tram from mine to mill having capacity of 25 tons per hour and length of 12,017 ft. Survey completed.

SEVEN TROUGHS COALITION (Seven Troughs)—Damage repaired in recently flooded workings and regular operations resumed at mine and mill.

NEVADA PACKARD (Lovelock)—During first 18 days of September, mill treated 1,900 tons, averaging about $10 per ton. Bullion valued at $8,400 recently shipped.

Nye County

TONOPAH ORE PRODUCTION for week ended Sept. 30 was 9,398 tons, valued at $195,044, compared with 9,568 tons for week previous. Producers were: Tonopah Belmont, 3,053 tons; Tonopah Extension, 2,200; Tonopah Mining, 1,700; Jim Butler, 1,200; West End, 656; Halifax, 212; Rescue-Eula, 212; Midway, 28; miscellaneous leases, 137 tons.

JIM BUTLER (Tonopah)—August profit $24,296 from treatment of 4,532 tons of ore shipped to the Belmont plant at Millers.

MIZPAH EXTENSION (Tonopah)—Crosscutting to north on 1,140-ft. level and to east on 1,300-ft. level. Property being developed by Tonopah Mining Co. under working option.

TONOPAH EXTENSION (Tonopah)—August profit was $64,506 from treatment of 9,247 dry tons of ore. Bullion production was: 1,648.85 oz. gold and 168,878 oz. silver. Sinking Victor shaft continues; now down about 1,650 ft.

TONOPAH BELMONT (Tonopah)—August profit, $92,636.07 from treatment of 12,364 tons. Bullion production 2,232.37 oz. gold and 199,445 oz. silver. Company started core drilling on East End company's ground as preliminary to further exploration. Additional drill will be in operation soon.

NEW JERSEY

AT BAYONNE employees of Tidewater Oil Co. are on strike. Riots occurred Oct. 11 and union leaders that evening voted to call strikes in plants of International Nickel, General Chemical, Pacific Coast Borax, and Edible Products companies. Bergenport Chemical Co. and some other Standard Oil subsidiaries, posted notices announcing plants would be "closed until further notice." Total of about 11,000 men affected.

NEW MEXICO

Grant County

BONNEY (Lordsburg)—Unwatered and ready to break ore on 4th level.

HANNOVER-BESSEMER (Fierro)—Erection of new 400-ton elctrostatic mill progressing satisfactorily.

Sierra County

LADY FRANKLIN (Kingston)—Percy Fern driving two tunnels.

EMPIRE ZINC (Kingston)—Making topographical survey of Kentucky Mountain; William McDonald driving Greer tunnel on 800-ft. level.

TEXAS

FREEPORT SULPHUR (Freeport)—Fourth pumping plant about completed; total daily capacity expected to be about 1,200 tons.

UTAH

Juab County

TINTIC SHIPMENTS for September 750 cars, or about 37,500 tons, by 34 shippers, compared to 720 cars in August. Dragon Consolidated, Chief Consolidated, Iron Blossom and Centennial-Eureka, largest shippers.

MAY DAY (Eureka)—Ore discovered below tunnel level; thought to be continuation of ore mined above.

TINTIC STANDARD (Eureka)—Extra shift to be put on to develop large orebody recently opened. Fan for ventilation to be installed shortly.

DRAGON CONSOLIDATED (Silver City)—New development to be undertaken on 1,000 level. September shipments were four cars daily. Large amount of iron ore being shipped.

IRON BLOSSOM (Silver City)—What appears important body copper ore—crosscut and drifted on for approximately 100 ft. in two directions—opened on 1,200 level. Winze sunk in ore of shipping grade down almost to 1,300 level. Drifting on 1,700 to prospect for downward extension of body. Increase from 25 to 100 tons of siliceous ore daily allowed by smelters.

Piute County

ARROWHEAD (Sevier Station)—General Connor mine, near Annie Laurie, recently acquired. Two quartz veins 5 to 14 ft. wide, carrying gold. Tunnel to be driven to connect with old workings. Bonds amounting to $15,000 sold to finance development. H. D. Chase, president.

Utah County

BAY STATE (American Fork)—Tunnel in 308 ft.; and drifting being done from near face. George Tyler, manager.

MINERAL FLAT (American Fork)—Tunnel in 2,100 ft.—being put in shape for further driving. Objective point intersection of fissure with ore-bearing limestone. Tunnel to be driven 300 to 500 ft., and crosscuts extended east and west. J. C. Jensen, manager.

WISCONSIN

M. & A. (Platteville)—New mill placed in operation at Rewey.

BELL (Platteville)—Company will commence milling within the next 10 days.

UTT-THORNE (Platteville)—Has taken over Big Eight mine on the Raisbeck land near Meeker's Grove and is installing surface equipment.

BLOCKHOUSE (Platteville)—Producing 40 to 50 tons per 10-hr. shift of 40% zinc concentrates; the first 10 cars of roasted ore sold have assayed over 62% zinc. Kistler & Stephens are the sole owners.

CANADA

British Columbia

STANDARD SILVER LEAD (Silverton)—Struck orebody of 3-ft. solid galena on two levels 40 ft. apart.

IVANHOE (Sandon)—One hundred ton mill replacing one burned last year about ready to start milling Surprise ores.

Ontario

ROSS (Porcupine)—Being diamond drilled.

McINTYRE (Porcupine)—Plant capacity being increased to 600 tons daily.

PETERSON LAKE (Cobalt)—Has found some good ore in old Nova Scotia property.

LITTLE NIPISSING (Cobalt)—High-grade 3-in. vein encountered on 100-ft. level.

SCHUMACHER (Schumacher)—Vein of sulphides showing free gold struck at 200-ft. level.

APEX (Porcupine)—Secured funds for development by issue of 500,000 shares; will resume operation.

THOMAS-HANNAH (Porcupine)—Contract let for several thousand feet of diamond drilling on this claim.

BURTON (Munro)—Contract let 4,000 ft. of diamond drilling. New vein carrying free gold found on surface.

DAVIDSON (Porcupine)—Cut new vein about 2 ft. wide, carrying much free gold. Contract let to sink shaft 100 ft.

NOVA SCOTIA (Cobalt)—Three high-grade veins uncovered on surface, from one of which a ton of ore has been bagged.

HURD CLAIMS (Kirkland Lake)—La Rose Consolidated has taken option on these claims, 1½ mi. south of the Tough Oakes.

BELLELLEN (South Lorrain)—An 8-in. vein of 2,000-oz. ore found at depth of 270 ft. in a winze and also in drift on 300-ft. level.

ADANAC (Cobalt)—Having realized $50,000 from sale of stock, will push development and sink shaft from 330 to 450 ft. to reach contact.

TOUGH OAKES (Kirkland Lake)—Production during August and September was approximately $175,000, being an average of $23 per ton milled.

HOLLINGER (Timmins)—For 28-day period ended Sept. 8, mill treated 50,177 tons, averaging $8.59; profit of $221,543—about $19,000 short of dividend requirements. Average running time was 90.4% and total operating costs were $3,628.

PITTSBURG LORRAIN (Silver Center)—This mine, also known as the Curry, has two good oreshoots and several small orebodies resulting from four years' steady development; approaching milling stage.

DOME (South Porcupine)—September production $179,500 from 38,300 tons, or average recovery of $4.68 a ton, a somewhat lower production than for preceding month. Costs were $2.59, as follows: Mining, 76c.; development charge, 60c.; crushing and conveying, 10c.; milling, 82c.; general, 31c.

MEXICO

SANTA GERTRUDIS (Pachuca, Hidalgo)—Treated in August, 23,424 tons; estimated profit, $33,500.

EL ORO MINING AND RY. (El Oro)—Operating staff ordered to return to mines, probably due to Carranza edict.

CHILE

BRADEN COPPER (Rancagua)—September output, 2,970,000 lb.; August, 2,616,000 lb. Plant extensions proceeding.

CHILE EXPLORATION (Chuquicamata)—Reported to have purchased copper properties of Cia. Minera de Calama for $1,280,000; includes Rosario del Llano, Buena Vista, Patagonia, Panizo, Poderosa and Carolina claims. September production 4,038,000 lb. copper; August, 3,020,000 lb.

CHOSEN

ORIENTAL CONSOLIDATED (Unsan)—Cabled report gives September cleanup as $128,800. Details of August cleanup follow: Bullion from Tabowie mill, $29,293; from Taracol mill, $25,106; from Maibong mill, $21,679; from Taracol cyanide plant, $52,110; from Maibong tube-mill plant, $3,545; total, $131,734. Tonnage milled during August, 26,895 tons. Water supply low and without rain soon will have to purchase more power than usual during coming winter.

The Market Report

Metal Markets

NEW YORK—Oct. 11

All of the metal markets were strong last week, copper scoring a substantial advance. Lead was very firm, but at unchanged prices. Spelter advanced sharply on speculative buying, but weakened upon the failure of consumers' buying to materialize so much as expected.

Copper, Tin, Lead and Zinc

Copper—There was somewhat larger business than in the previous week, our reports amounting to 23,250,000 lb., compared with about 20,000,000 lb. in the previous week. The bulk of the business was taken by a few agencies, others failing to participate broadly in the business, for one reason or another. Right from the beginning of the week prices exhibited an advancing tendency, this being apparently a belated reflection of the extraordinarily strong statistical position. On Oct. 7 important business was done at 27½c., r. t. for January-March delivery. Having made sales at that figure, certain of the largest agencies advanced their asking price.

The shock received by all markets from the submarine exploits off Nantucket, which the newspapers reported on Oct. 9, killed business. Practically all of the business done during the last week was concentrated in the three days, Oct. 5-7. During that time there were a few sales for export, but the great bulk of the business was for domestic account. Wire drawers were large buyers. By far the major part of the business was for delivery in the first quarter of 1917 and was done at prices ranging from 26¾c., net cash, New York, at the beginning, to 27¼c. at the end. There was a certain volume of business done with belated consumers for prompt delivery at 29c., r. t., and there was some for December delivery at 28c., r. t. The average realized on all business reported was 27@27⅛c., net cash, New York.

The steamship "Strathdene" sunk by German submarine "U-53," carried down a large quantity of both copper and spelter, which it is figured must be replaced immediately in this market.

Copper Sheets, base price, nominally 37½c. for hot rolled and 38½c. for cold rolled for delivery at mill convenience. Earlier deliveries mainly on toll basis.

Copper Exports from Atlantic ports in September are estimated at 29,803 gross tons.

Visible Stocks of Copper in Europe Sept. 30 are reported as follows: Great Britain, 3,162; France, 2,634; afloat from Chile, 1,575; afloat from Australia, 3,000; total, 10,371 gross tons, or 23,231,040 lb. This is a decrease of 1,297 tons from the Sept. 15 report.

Tin—This market advanced sharply, especially in the spot position, owing to the fear of interruption of imports. Up to Monday tin for future delivery was about unchanged in price, but on Oct. 10 there was a sharp advance, following a big rise in the East. A large business in tin was done in this market right through the week. Tin for future delivery opened at 39¾c., rose to 40¾c., on Oct. 10, and closed at 40⅝c., on Oct. 11.

Visible Stocks of Tin Sept. 30 were, including tin afloat: London, 7,320; Banka, 1,263; United States excluding Pacific ports, 7,609; total, 16,192 gross tons, which is 1,850 tons less than on Aug. 31, but 1,001 tons more than on Sept. 30 last year.

Lead—This market was active, there being a better demand and an increased volume of business as compared with the previous week. Canada, South America and Holland were buyers, and there were inquiries from Russia, with prospects that some further business would soon be consummated in that quarter. Prices were unchanged, but were very firm. The statistical position becomes stronger and stronger in favor of the producers. There is prospect that lead for November delivery will presently become quite as scarce as October delivery is now. A contributory factor is the falling down in output of at least three important refineries, which occurred in the early part of this month. The explanation of this is increasing inefficiency of labor.

Spelter—The improvement that began last week continued through Oct. 5 and 6, when a sharp advance in price occurred. This was due to speculative buying. On Oct. 5 the market for prompt spelter momentarily touched 10c. The advance in prices did not have the expected effect of bringing consumers into the market in a broad way, discovering which some producers took what consuming business there was, including some from galvanizers, at a little lower prices. On Monday the news of the exploits of the "U-53" produced a shock that killed all prospects of business and the market became distinctly stale.

Brass special spelter is quoted at 10¼c., intermediate at 14@15c., and high grade at 15@16 cents.

Zinc Sheets are in steady demand. Base price is unchanged at $15 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Other Metals

NEW YORK—Oct. 11

Aluminum—Stocks for early delivery are still very scarce. Quotations are 65@67c. per lb. for No. 1 ingots.

Antimony—This market became distinctly stronger through the development of a demand which resulted in large business, upward of 1,000 tons being reported done. We quote 11½@12½c. per lb., New York.

Quicksilver—This market advanced further, on good demand and small supply. We quote $80 per flask. San Francisco reports, by telegraph, $74@75, market firm.

Nickel—Demand and prices steady at 45@50c. per lb. for ordinary forms, with 5c. premium for electrolytic.

Minor Metals—Current quotations for **Bismuth** are $3.15@3.30 per lb., New York—**Cadmium** is quoted at $1.30@1.50 per lb.—**Cerium**, electrolytic, is sold at $8@9 per lb.—**Cobalt Metal** is quoted at $1.25 per lb.—**Magnesium** is steady, with sales at $3.50@3.75 per lb. for 99% pure—**Selenium** is from $3 up to $5 per lb., according to size of order.

Gold, Silver and Platinum

NEW YORK—Oct. 11

Gold in the United States Oct. 1 is estimated by the Treasury Department as follows: Held against gold certificates outstanding, $1,704,948,269; in Treasury current balances, $275,579,465; in banks and circulation, $655,481,834; total, $2,636,009,568. This is an increase of $494,227,309 over Oct. 1 last year.

Silver—The market is steady with present demand chiefly for coinage. Recent silver shipments from China to India have tended to firm up the exchanges of the former country. Supplies from this side have shown some increase, judging from from last week's shipments to London.

Mexican dollars in New York were quoted Oct. 5 at 53@56c.; Oct. 6 at 53@56c.; Oct. 7 at 52½@55½c.; Oct. 9 at 52½@55½c.; Oct. 10 at 52@55c.; Oct. 11 at 52⅛@55⅛c. Demand and supply have both been light.

Coined Silver in the United States Oct. 1 is estimated by the Treasury Department as follows: Standard dollars, $568,270,319; subsidiary coins, face value, $189,869,616; total, $758,139,935. Of the standard dollars $485,162,915 are held in Treasury against silver certificates outstanding.

Platinum—This market was quiet, the demand having become rather light. However, the price holds firmly. We quote $89@90 per oz. Iridoplatinum (hard metal) with 10% iridium, is quoted at $96.

Palladium—Quoted at $75 per oz. Some business.

Zinc and Lead Ore Markets

Platteville, Wis., Oct. 7—Quotations of the district are according to the following figures: Base price per 2,000-lb. ton for material assaying 60% zinc is $60 for premium ore down to $50 for medium-grade. For material assaying 80% lead the base price per 2,000-lb. ton is $74. Shipments for the week were 2,654 tons of zinc ore, 153 tons of lead ore, and 721 tons of sulphur ore. For the year to date the figures are 96,590 tons of zinc ore, 3,428 tons of lead ore, and 23,723 tons of sulphur ore. Shipped during week to separating plants, 2,621 tons of zinc ore.

Joplin, Mo., Oct. 7—Price quotations per 2,000 lb.: Blende, high, $68.75; 60% zinc, premium ore, $67.50; medium grades, $68@60; low, $60; calamine, per ton 40% zinc, $45@35; average selling price, all grades of zinc, $60.99 per ton. Lead, base price, $75@80 per ton 80% metal content; high price, $78.80; average selling price, all grades of lead, $74.10 per ton.

Shipments of the week, blende, 8,500 tons; calamine, 425 tons; lead, 950 tons. Value, all ores, $614,740, the week; $28,817,810 the year to date.

Other Ores

Manganese Ore—The Steel Corporation, it is reported, has closed a contract for 200,000 tons Brazilian manganese ore for delivery through 1917. The ore will average 48% manganese. The price is 48c. per unit at Rio Janeiro. At current freight rates this will be 70@75c. per unit at Baltimore.

Tungsten Ore—We quote this market at $17 per unit, considerable business done.

Antimony Ore—There was some demand for small quantities, $1.10@1.25 per unit being paid, according to grade of ore.

SILVER AND STERLING EXCHANGE

Oct.	Sterling Exchange	Silver New York, Cents	Silver London, Pence	Oct.	Sterling Exchange	Silver New York, Cents	Silver London, Pence
5	4.7569	67½	32⅛	9	4.7569	67½	32⅛
6	4.7569	68¼	32⅛	10	4.7569	67½	32⅛
7	4.7569	68¼	32⅛	11	4.7569	67⅝	32⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine.

DAILY PRICES OF METALS IN NEW YORK

Oct.	Copper Electrolytic	Tin Spot.	Lead N. Y.	Lead St. L.	Zinc St. L.
5	26⅛ @27	39⅞	7.00	6.82½ @6.92½	9.37½ @10.00
6	26⅛ @27½	40	7.00	6.82½ @6.92½	9.40 @9.80
7	27 @27½	40	7.00	6.82½ @6.92½	9.50 @9.75
9	27 @27½	43¼	7.00	6.82½ @6.92½	9.50 @9.62½
10	27 @27½	43	7.00	6.82½ @6.92½	9.50 @9.62½
11	27 @27½	42½	7.00	6.82½ @6.92½	9.50 @9.92½

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is basing point.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" (r.t.) is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only St. Louis price is given, St. Louis being basing market. We quote New York price at 17c. per 100 lb. above St. Louis.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1 cents.

LONDON

Oct.	Copper Standard Spot	Copper Standard 3 Mos.	Copper Electrolytic	Tin Spot	Tin 3 Mos.	Lead Spot	Zinc Spot
5	120	116½	141	177½	178	31	54
6	120½	117	142	177¼	177½	30¾	54½
7	....	....	....	....	....	....	....
9	121	117½	142	178	178½	30¾	57
10	123	119	142	181	181½	30¾	56
11	123½	119½	142	180	180½	30½	56

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2,240 lb. Copper quotations for electrolytic are subject to 3% discount. For convenience in comparison of London prices, in pounds sterling per 2,240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c Variations, £1 = 0.21½ cents.

Iron Trade Review

NEW YORK—Oct. 11

The chief development at present is the strengthening of the pig-iron market. A heavy demand for export has stimulated domestic buying and made prices firmer. Special demand is for basic pig, but foundry is also in request.

Pig Iron Production, estimated for September at 3,238,400 gross tons; nine months to Sept. 30 at 29,360,100 tons. Oct. 1 there were 328 coke and anthracite furnaces in blast, with total daily make of 106,600 tons.

United States Steel Corporation reports unfilled orders Sept. 30 at 9,552,584 tons, a decrease of 137,773 tons during September.

PITTSBURGH—Oct. 10

The September decrease of 137,718 tons in the Steel Corporation's unfilled obligations does not represent any weakness in the trade, as it would have been possible to put much more business on the books. The mills were very reserved about booking business and in some of the products were already practically filled for the delivery period they were willing to consider. In the past four months the net decrease in the corporation's obligations represents no more than nine days' production, and the present obligations represent a tonnage equal to seven months of production. Fully 60% of the obligations, or as large a proportion as at any time, is in the form of actual specifications.

The Phillips Sheet and Tin Plate Co., the largest independent tinplate maker, has announced a price of $6 per base box for tinplate for the first half of 1917 and most of the independents have opened their books. The leading interest will open its books for both sheets and tinplates within a couple of days. The tinplate price is the highest on record. Last season's price was $3.60.

Steel production is increasing, the weather being now very favorable, and this month's outtout will probably be the largest yet, but there is as great pressure as formerly for deliveries. Steel prices are advancing.

For several months railroad buying has amounted to practically nothing, and a resumption was hardly expected until prices were lower, but there has been a definite resumption.

Pig Iron—We quote: Bessemer, $23; basic, malleable and foundry, $20; forge, $19.50, f.o.b. Valley furnaces, 95c. higher delivered Pittsburgh.

Ferroalloys

Production of spiegeleisen and ferromanganese in the United States nine months ended Sept. 30 is estimated at 305,576 gross tons, an increase of 148,489 tons over last year.

Ferrosilicon is unchanged, high grade, $86@89, low grade, $31@41 at furnace.

Spiegeleisen is steady, 20% quoted at $35@45 per ton at furnace.

Ferromanganese—Since the recent open competition the market has been steady, contract being quoted at $164 for imported and $165 for domestic. Spot lots stand at about the same level. August imports were 8,525 tons, making the total for eight months 48,687 tons.

IRON ORE

Shipments of Lake Superior iron ore in September were 9,600,786 gross tons. For the season to Oct. 1 the total shipments were, in gross tons:

Port	1915	1916	Changes
Escanaba	4,011,682	5,630,994	I. 1,619,312
Marquette	2,313,532	3,026,845	I. 713,313
Ashland	3,829,582	6,051,712	I. 2,222,130
Superior	5,997,023	9,760,966	I. 3,763,943
Duluth	11,807,219	16,174,159	I. 4,366,940
Two Harbors	6,710,528	8,171,974	I. 1,461,446
Total	34,669,566	48,816,650	I14,147,084

Some round tonnages of New Jersey nonbessemer magnetite ores analyzing 58 to 60% iron for delivery over the first half of 1917, have been sold to eastern Pennsylvania furnaces on the basis of 9c. per unit, delivered. A higher price is now asked.

Coke

Coke production in the Connellsville region week ended Sept. 30 is reported by the "Courier" at 412,364 net tons; shipments, 421,196 tons. Upper Connellsville and Greensburg shipments, 41,529 tons.

Chemicals

NEW YORK—Oct. 11

The general market is steady with a good undertone.

Arsenic—Quiet and a little easier. Sales, $5.75 @6 per 100 lb. according to quantity.

Copper Sulphate—Steady. Sales at $10@10.25 per 100 lb. according to order.

Nitrate of Soda—Unchanged at $2.90@2.95 per 100 lb. for spot and futures.

STOCK QUOTATIONS

N. Y. EXCH.†	Oct. 10
Alaska Gold M.	12⅛
Alaska Juneau	6⅛
Am. Sm. & Ref., com.	108⅛
Am. Sm. & Ref., pf.	116
Am. Sm. Sec., pf. A	96⅛
Am. Sm. Sec., pf. B	88
Am. Zinc	47
Am. Zinc, pf.	77⅛
Anaconda	93⅛
Batopilas Min.	1⅛
Bethlehem Steel	535
Bethlehem Steel, pf.	130
Butte& Superior	64
Chile Cop.	21
Chino	53⅛
Colo. Fuel & Iron	54⅛
Crucible Steel	85⅛
Dome Mines	24⅛
Federal M. & S.	16
Federal M. & S., pf.	39
Great Nor., ore ctf.	41⅛
Greene Cananea	50⅛
Homestake	133⅛
Inspiration Con.	65
International Nickel	51⅛
Kennecott	52⅛
Lacakawanna Steel	85
Miami Copper	37⅛
Nat'l Lead, com.	69
National Lead, pf.	114
Nev. Consol.	21⅛
Ontario Min.	6
Quicksilver	12⅛
Quicksilver, pf.	14
Ray Con.	24⅛
Republic I.&S., com.	74⅛
Republic I. & S. pf.	112⅛
Sloss-Sheffield	59⅛
Tennessee Copper	22
Utah Copper	94⅛
U. S. Steel, com.	111⅛
U. S. Steel, pf.	120⅛
Va. Iron C. & C.	45⅛

N. Y. CURB†	Oct. 10
Beaver Con.	.41⅛
Buffalo Mines	1
Butte & N. Y.	1⅛
Butte C. & Z.	7⅛
Caledonia	.59
Can. Cop. Corpn.	1⅛
Cashboy	.05
Cerro de Pasco	39
Con. Ariz. Sm.	1⅛
Con. Coppermines	2⅛
Con. Nev.-Utah	⅛
Crystal Cop.	1⅛
First Nat. Cop.	4⅛
Florence	.72
Goldfield Con.	.61
Goldfield Merger	.08
Granite	.40
Hecla Min.	5⅛
Howe Sound	5⅛
Jerome Verde	2
Joplin Ore & Spel.	.50
Kerr Lake	4⅛
Magma	17⅛
Majestic	.60
McKinley-Dar-Sa.	.60
Mother Lode	.34
Nevada Hills	.20
N. Y. & Hond.	.15⅛
Nipissing Mines	8⅛
Oro	.04
Ray Hercules	3⅛
Rochester Mines	.58
St. Joseph Lead	18⅛
Standard S. L.	1 1/16
Stewart	.22
Success	.41
Tonopah	5⅛
Tonopah Ex.	5⅛
Tribullion	⅛
United Zinc	5
White Knob, pf.	1⅛
White Oaks	4⅛
Yukon Gold	2⅛

SAN FRAN.*	Oct. 10
Alta	.05
Andes	.11
Best & Belcher	.05
Bullion	.01
Caledonia	.30
Challenge Con.	‡.08
Confidence	.20
Cons. Imperial	‡.01
Con. Virginia	.12
Gould & Curry	.03
Hale & Norcross	.05
Jacket-Cr. Pt.	.05
Mexican	.15
Occidental	.70
Ophir	.18
Overman	‡.06
Savage	.11
Seg Belcher	.02
Sierra Nevada	.28
Union Con.	.56
Utah Con.	.02
Belmont	4.50
Jim Butler	.90
MacNamara	.07
Midway	.26
Mont.-Tonopah	.22
North Star	.15
Rescue Eula	.23
West End Con.	.73
Atlanta	.09
Blue Bell	‡.01
Booth	.11
C.O.D. Con.	.03
Comb. Frac.	.06
D'field B.B.	.04
D'field Daisy	.05
Jumbo Extension	.38
Round Mountain	.38
Sandstorm Kendall	.04
Silver Pick	.19
Central Eureka	.05
Argo	.11
Ariz. Central	.10
Big Jim	1.31⅛
Lazy Boy	.10
Oatman No. Star	‡.14
Tom Reed	2.15
United Eastern	3.62⅛
United Western	.08

BOSTON EXCH.*	Oct. 10
Adventure	3⅛
Ahmeek	102⅛
Algomah	1⅛
Allouez	68
Ariz. Com., crfs.	12⅛
Bonanza	.40
Butte-Ballaklava	1⅛
Calumet & Ariz.	74⅛
Calumet & Hecla	570
Centennial	20⅛
Copper Range	66⅛
Daly West	2⅛
East Butte	15
Franklin	8
Granby	90
Hancock	13⅛
Helvetia	.30
Indiana	3⅛
Island Cr'k, com.	44
Island Cr'k, pfd.	90
Isle Royale	31⅛
Keweenaw	5⅛
Lake	13⅛
La Salle	4⅛
Mason Valley	5⅛
Mass	15
Mayflower	2⅛
Michigan	3⅛
Mohawk	90⅛
New Arcadian	6⅛
New Idria	14
North Butte	20⅛
North Lake	1⅛
Ojibway	1⅛
Old Colony	2⅛
Old Dominion	69⅛
Osceola	88
Quincy	88
St. Mary's M. L.	86
Santa Fe	1⅛
Shannon	9⅛
Shattuck-Ariz.	28
So. Lake	5⅛
So. Utah	.25
Superior	15⅛
Superior & Bost.	4⅛
Tamarack	41⅛
Trinity	7⅛
Tuolumne	.67
U. S. Smelting	72
U. S. Smelt'g, pf.	51⅛
Utah Apex	3⅛
Utah Con.	14⅛
Utah Metal	7⅛
Victoria	4
Winona	5
Wolverine	46⅛
Wyandot	1⅛

BOSTON CURB*	Oct. 10
Bingham Mines	10⅛
Boston Ely	.80
Boston & Mont.	.88
Butte & Lon'n Dev.	.68
Calaveras	5⅛
Calumet-Corbin	.02⅛
Chief Con.	2
Cortez	.30
Crown Reserve	.52
Davis-Daly	2⅛
Eagle & Blue Bell	1⅛
Houghton Copper	1⅛
Iron Cap Cop., pf.	5⅛
Mexican Metals	.33
Mines of America	2⅛
Mojave Tungsten	3⅛
Nat. Zinc & Lead	.57
Nevada-Douglas	1⅛
New Baltic	1⅛
New Cornelia	16⅛
Ohio Copper	.15
Oneco	.80
Raven Copper	‡.07
Rex Cons.	.29
Rilia	.10
United Verde Ext.	39⅛

SALT LAKE*	Oct. 10
Big Four	.96
Black Jack	.11
Cardiff	7.50
Colorado Mining	.19
Crown Point	.07
Daly-Judge	7.95
Emma Cop.	2⅛
Gold Chain	.20
Grand Central	.74
Iron Blossom	1.55
Lower Mammoth	.05
May Day	.13
Opohongo	‡.01⅛
Prince Con.	1.35
Seven Troughs	‡.03
Silver-King Coal'n	2.97½
Silver King Con.	3.67½
Sioux Con.	.16
So. Hecla	2.15
Uncle Sam	.04
Wilbert	.08
Yankee	.21

TORONTO*	Oct. 10
Adanac	‡.25
Bailey	.07⅛
Chambers Ferland	.17
Coniagas	4.90
La Rose	.57
Peterson Lake	.22
Right of Way	.05
Seneca Superior	.10
T. & Hudson Bay	70.00
Temiskaming	.62
Wettlaufer-Lor.	.11
Dome Exten.	.34
Dome Lake	.59½
Foley O'Brien	.70
Hollinger	6.75
Jupiter	.26
McIntyre	1.44
Newray	.70
Porcu. Crown	.70
Vipond	.37
West Dome	.34

STOCK QUOTATIONS—Continued

COLO. SPRINGS	Oct. 10
Doctor Jack Pot	.09⅛
Elkton Con.	.16
El Paso	.40
Findlay	‡.03⅛
Gold Sovereign	.06⅛
Golden Cycle	2.29
Granite	.74
Isabella	.22⅛
Jack Pot	.05
Mary McKinney	.31
Portland	1.92
Vindicator	1.97

LONDON	Sept. 26
Alaska-Mexican	£0 17s6d
Alaska Tre'dwell	4 5 0
Burma Corp.	4 3 4
Cam & Motor	0 11 3
Camp Bird	0 7 6
El Oro	0 9 6
Esperanza	0 11 6
Mexico Mines	3 17 6
Nechi, pfd.	0 13 0
Oroville	0 16 9
Santa Gert'dis	0 12 0
Tomboy	1 1 6

* Bid prices. † Closing prices. ‡ Last Quotations.

MONTHLY AVERAGE PRICES OF METALS

Silver	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.960
February	57.506	48.477	56.755	26.573	22.753	26.975
March	58.067	50.241	57.935	26.788	23.708	27.597
April	58.519	50.250	64.415	26.958	23.709	30.662
May	58.175	49.915	74.269	26.704	23.570	35.477
June	56.471	49.034	65.024	25.948	23.267	31.060
July	54.678	47.519	62.940	25.219	22.597	30.000
August	54.344	47.163	66.083	25.979	22.780	31.498
September	53.290	48.680	68.515	24.260	23.591	32.584
October	50.654	49.385	.....	23.199	23.925	.....
November	49.082	51.714	.....	22.703	25.094	.....
Dec.	49.375	54.971	.....	22.900	26.374	.....
Year	54.811	49.684	.....	25.314	23.675	.....

New York quotations cents per ounce troy, fine silver: London, pence per ounce, sterling silver, 0.925 fine.

Copper	New York		London			
	Electrolytic		Standard		Electrolytic	
	1915	1916	1915	1916	1915	1916
Jan.	13.641	24.008	60.756	88.083	65.719	116.167
Feb.	14.394	26.440	63.494	102.667	*	133.167
Mar.	14.787	26.310	66.152	107.714	*	136.000
April	16.811	27.895	75.096	124.319	*	137.389
May	18.506	28.625	77.600	135.457	*	152.522
June	19.477	26.601	82.574	112.432	95.333	137.455
July	18.796	23.865	76.011	95.119	91.409	125.500
Aug.	16.941	26.120	68.673	110.283	82.333	126.304
Sept.	17.502	26.855	68.915	113.905	85.250	134.071
Oct.	17.686	.....	72.601	.....	88.000	.....
Nov.	18.627	.....	77.744	.....	93.273	.....
Dec.	20.133	.....	80.773	.....	100.430	.....
Year	17.275	.....	72.532	.....	.....	.....

Tin	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	42.717	176.925	181.107
March	48.426	50.741	180.141	193.609
April	47.884	51.230	166.225	199.736
May	38.790	49.125	162.675	196.511
June	40.288	42.231	167.636	179.466
July	37.423	38.510	167.080	168.357
August	34.389	38.565	151.440	169.870
September	33.125	38.830	152.625	171.345
October	33.080	.....	151.554	.....
November	39.224	.....	167.670	.....
December	38.779	.....	167.000	.....
Av. year	38.590	.....	163.960	.....

Lead	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	6.246	3.718	6.164	19.122	31.988
March	4.053	7.136	3.997	7.375	21.883	34.440
April	4.221	7.630	4.142	7.655	21.094	34.368
May	4.274	7.463	4.182	7.332	20.347	32.967
June	5.932	6.936	5.836	6.749	25.170	31.011
July	5.659	6.352	5.531	6.185	24.611	28.137
August	4.656	6.244	4.520	6.088	21.946	29.734
September	4.610	6.810	4.490	6.699	23.151	30.786
October	4.600	.....	4.499	.....	23.994	.....
November	5.155	.....	5.078	.....	26.278	.....
December	5.355	.....	5.266	.....	28.807	.....
Year	4.673	.....	4.567	.....	22.917	.....

Spelter	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan.	6.386	16.915	6.211	16.745	30.844	89.810
Feb.	8.436	18.420	8.255	18.260	39.819	97.762
Mar.	8.541	16.846	8.360	16.676	44.141	95.048
April	10.012	16.695	9.837	16.525	49.888	99.056
May	14.781	14.276	14.610	14.106	68.100	94.217
June	21.208	11.752	21.038	11.582	100.614	68.591
July	19.026	8.925	18.856	8.755	97.250	50.750
Aug.	12.781	8.730	12.611	8.560	67.786	51.587
Sept.	13.440	8.990	13.270	8.820	67.841	52.095
Oct.	12.800	.....	12.596	.....	66.536	.....
Nov.	15.962	.....	15.792	.....	88.409	.....
Dec.	15.391	.....	15.221	.....	89.400	.....
Year	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported.

Pig Iron, Pitts.	Bessemer‡		Basic‡		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	21.16	13.45	18.93	13.90	19.51
March	14.55	21.81	13.45	19.20	13.95	19.45
April	14.55	21.65	13.45	18.95	13.95	19.45
May	14.61	21.78	13.60	19.11	13.83	19.58
June	14.70	21.95	13.67	18.95	13.77	19.34
July	14.94	21.95	13.91	18.95	13.68	19.20
August	16.01	21.95	15.31	18.95	14.75	19.25
September	16.86	22.88	15.95	19.58	15.70	19.53
October	16.95	.....	15.96	.....	15.80	.....
November	17.57	.....	16.47	.....	17.20	.....
December	19.97	.....	18.44	.....	18.95	.....
Year	$15.82	.....	$14.76	.....	$14.95	.....

‡ As reported by W. P. Snyder & Co.

Mining Companies—United States

Name of Company and Situation		Shares Issued	Par	Dividends Total	Latest	Amt.
Acacia, g.	Colo.	1,438,989	$ 1	$ 122,004	Jan '11	$0.01
Ahmeek, c.	Mich.	200,000	25	4,950,000	July '16	3.00
Alaska Mexican, g.	Alas.	180,000	5	3,507,381	Nov. '15	0.10
Alaska Treadwell, g.	Alas.	200,000	25	15,785,000	May '16	0.50
Alaska United, g.	Alas.	180,200	5	2,045,270	Feb. '16	0.30
Allouez, c.	Mich.	100,000	25	550,000	July '16	2.00
Am. Sm. & Ref., com	U. S.	501,080	100	31,337,653	Sept. '16	1.50
Am. Sm. & Ref., pf.	U. S.	500,000	100	57,431,386	Sept. '16	1.75
Am. Smelters, pf. A.	U. S.	166,498	100	11,433,788	July '16	1.50
Am. Smelters, pf. B.	U. S.	300,000	100	16,635,000	July '16	1.25
Am. Zinc, Lead & Sm.	U. S.	228,120	25	1,108,820	Apr. '13	0.50
Anaconda, c.	Mont.	2,331,250	50	111,229,375	Aug. '16	2.00
Argonaut, g.	Calif.	200,000	5	1,760,000	Sept. '16	0.10
Arizona Copper, com.	Ariz.	1,519,896	1.20	18,470,646	July '16	0.36
Arizona Copper "A," pf.	Ariz.	160,000	1.20	247,795	Apr. '16	
Arizona Copper, pf.	Ariz.	1,266,120	1.20	1,940,880	May '16	
Baltic, c.	Mich.	100,000	25	7,950,000	Dec. '13	2.00
Barnes-King, c.	Mont.	400,000	5	60,000	June '16	0.075
Bingham N. H., c.	Utah.	228,689	5	960,493	Dec. '15	0.05
Bonanza Dev., g.	Colo.	300,000	1	1,425,000	Oct. '11	0.20
Brunswick, g.	Calif.	395,287	1	203,315	Sept. '15	0.06
Bunker Hill Con., g.	Calif.	200,000	1	866,000	Sept. '16	0.02½
Bunker Hill & Sul., l.s.	Ida.	327,000	10	18,081,000	Sept. '16	0.50
Butte-Alex Scott, c.	Mont.	79,311	10	1,054,119	Apr. '16	10.50
Butte-Ballaklava, c.	Mont.	250,000	10	125,000	Aug. '10	0.50
Butte & Superior, z.	Mont.	290,069	10	13,195,955	Sept. '16	6.25
Caledonia, l.s.c.	Ida.	2,605,000	1	1,560,031	Sept. '16	0.03
Calumet & Arizona, c.	Ariz.	641,602	10	26,949,457	Sept. '16	2.00
Calumet & Hecla, c.	Mich.	100,000	25	134,250,000	Sept. '16	20.00
Camp Bird, g.s.	Colo.	1,100,051	5	10,917,116	July '16	0.17
Centen'l-Eur., l.s.g.c.	Utah.	100,000	5	4,150,000	Apr. '16	1.00
Center Creek, l.z.	Mo.	100,000	10	595,000	July '16	0.15
Champion, c.	Mich.	100,000	25	16,040,000	Sept. '16	6.40
Chief Consolidated, s.g.l.	Utah.	880,676	1	483,367	Aug. '16	0.05
Chino, c.	New Mex.	869,980	5	11,700,380	Sept. '16	2.25
Cliff, g.	Utah.	300,000	1	90,000	Jan. '13	0.10
Cliff, g.	Alas.	100,000	1	210,000	Oct. '13	0.01
Colo. Gold Dredging.	Colo.	100,000	10	775,000	Feb. '16	1.00
Colorado, l.s.g.	Utah.	1,000,000	0.20	2,570,000	Dec. '12	0.03
Commercial Gold	Ore.	1,666,000	1	230,490	May '16	0.00½
Cons. Inter. Callahan l.z.	Ida.	464,990	10	4,649,900	Sept. '16	1.50
Continental, z.l.	Mo.	22,000	25	583,000	July '16	1.00
Copper Range, c.	Mich.	394,001	25	17,729,756	Sept. '16	2.50
Cresson Con	Colo.	1,220,000	1	3,672,162	Sept. '16	0.10
Daly West, s.l.	Utah.	180,000	20	6,606,000	Jan. '13	0.15
Doctor Jackpot, g.	Colo.	3,000,000	0.10	84,814	Mar. '10	0.00½
Doe Run, l.	Mo.	65,749	100	3,550,969	Dec. '13	0.76
Eagle & Blue Bell, g.s.l.	Utah.	893,146	1	491,230	July '16	0.05
Elkton Con., g.	Colo.	2,500,000	1	3,579,460	May '15	0.02
El Paso, g.	Colo.	490,000	5	1,707,545	Feb. '14	0.10
Ernestine, g.s.	N.M.	300,000	5	150,000	July '15	0.10
Fed. M. & S., com.	Idaho.	60,000	100	2,708,750	Jan. '09	1.50
Fed. M. & S., pf.	Idaho.	120,000	100	12,936,795	Sept. '16	1.00
Florence, g.	Nev.	1,050,000	1	840,000	Apr. '11	0.10
Free Coinage, g.	Colo.	10,000	100	180,000	Dec. '09	1.00
Fremont Con., g.	Calif.	200,000	2.50	258,000	Oct. '14	0.02
Frontier, z.	Wis.	1,250	100	146,202	Nov. '13	2.00
Gemini-Key'ne, l.g.s.	Utah.	5,000	100	2,330,000	June '16	5.00
General Dev	U. S.	120,000	25	3,503,917	Sept. '16	1.50
Gold Chain, g.	Utah.	1,000,000	1	130,000	May '13	0.03
Gold Dollar Con.	Colo.	2,500,000	0.10	100,000	Dec. '12	0.00½
Gold King Con., g.	Colo.	1,000,000	1	1,417,319	Nov. '15	0.01
Golden Cycle, g	Colo.	1,500,000	1	7,578,300	Sept. '16	0.02
Golden Star, g.	Ariz.	400,000	5	140,000	Mar. '10	0.05
Goldfield Con., g.	Nev.	3,559,148	10	28,999,832	Oct. '15	0.10
Good Springs Anchor, s.	Nev.	550,000	1	108,785	May '16	0.01
Grand Central, g.	Utah.	500,000	1	1,633,250	Dec. '15	0.02½
Granite, g.	Colo.	1,650,000	1	286,500	Dec. '12	0.01
Hazel, g.	Cal.	900,000	1	971,000	Dec. '13	0.01
Hecla, l.s.	Idaho.	1,000,000	0.25	4,855,000	Sept. '16	0.15
Hercules, l.s.	Idaho.	1,000,000	1	12,600,500	Sept. '16	0.30
Homestake, g.	S. D.	251,160	100	40,361,194	Sept. '16	0.65
Horn Silver, l.s.z.	Utah.	400,000	25	5,682,000	June '16	0.05
Inspiration, c.	Ariz.	1,159,471	20	3,768,281	July '16	2.00
Inter'l Nickel, com.	U. S.	1,673,384	25	33,451,414	Sept. '16	1.50
Inter'l Nickel, pfd.	U. S.	89,126	100	5,748,513	Aug. '16	1.50
Iowa, g.s.l.	Colo.	1,666,667	1	270,167	Dec. '15	0.00½
Iowa-Tiger, g.s.	Colo.	3,000	1	25,179	Dec. '15	1.00
Iron Blossom, s.l.g.	Utah.	1,000,000	0.10	2,750,000	July '16	0.10
Iron Silver, s.l.g.	Colo.	500,000	20	4,950,000	Dec. '14	0.10
Jamison, g.	Cal.	390,000	10	386,100	Dec. '15	0.01
Jerry Johnson, g.	Colo.	2,500,000	0.10	187,500	Nov. '14	0.01
Jim Butler-Tonopah, g.s	Nev.	1,718,021	1	515,406	Aug. '16	0.10
Judge M. & S., s.l.	Utah.	480,000	1	1,350,000	July '16	0.25
Jumbo Extension, g.	Nev.	1,550,000	1	685,000	June '16	0.05
Kendall, g.	Mont.	500,000	5	1,555,000	Apr. '16	0.10
Kennecott Cop., c.	Alas.	2,780,583		11,121,848	Sept. '16	1.50
Kennedy, g.	Cal.	100,000	100	1,831,001	Apr. '10	0.03
Klar Piquette, z.l.	Wis.	20,000	1	259,000	Apr. '13	0.50
Knob Hill, g.	Wash.	1,000,000	1	70,000	Oct. '13	0.00½
Liberty Bell, g.	Colo.	133,551	5	1,752,795	Sept. '15	0.20
Little Bell, l.s.	Utah.	300,000	1	90,000	Apr. '16	0.05
Magma, c.	Ariz.	240,000	5	600,000	Sept. '16	0.50
Mammoth, g.s.c.	Utah.	400,000	2.50	2,360,000	June '16	0.05
Mary McKinney, g.	Colo.	1,309,252	1	1,169,306	July '14	0.02
May Day, g.s.l.	Utah.	800,000	0.25	284,000	May '16	0.02
Mexican, g.s.	Nev.	201,600	2.50	161,910	June '14	0.75
Miami, c.	Ariz.	747,114	5	8,575,112	Aug. '16	1.50
Modoc, g.s.	Colo.	500,000	1	275,000	Dec. '11	0.01
Mohawk, c.	Mich.	100,000	25	5,575,000	Aug. '16	10.00
Monarch-Mad'a, g.s.l.	Colo.	1,000,000	1	40,000	May '11	0.01
Montana-Tonop., s.g.	Nev.	921,865	1	488,588	Dec. '12	0.10
Mountain, c.	Cal.	250,000	25	4,216,250	May '08	0.44
National, g.	Nev.	750,000	1	570,000	May '11	0.10
National Lead, com.	N. Y.	206,554	100	9,655,216	Sept. '16	1.00
National Lead, pf.	N. Y.	243,676	100	32,632,551	Sept. '16	1.75
Nevada Con., c.	Nev.	1,999,457	5	24,474,937	Sept. '16	1.00
New Idria, q.	Cal.	100,000	5	2,030,000	June '16	1.00
North Butte, c.	Mont.	430,000	15	13,244,500	July '16	0.75
North Star, g.	Cal.	250,000	10	4,962,040	Sept. '16	0.20
Old Dominion, (holding)	Ariz.	293,353	25	9,813,978	Sept. '16	3.00
Old Domin'n, M. & Sm.	Ariz.	162,000	25	7,857,000	Sept. '16	3.00

Corrected to October 1, 1916.

Mining Companies—United States—(*Continued*)

Name of Company and Situation		Shares Issued	Par	Dividends Total	Latest	Amt.
Ophir, s.g.	Nev.	201,600	$3	$ 2,068,360	Jan. '12	$0.10
Opohongo, g.s.l.	Utah.	898,978	0.25	80,907	Jan. '13	0.02
Oroville Dredging.	Cal.	686,538	5	2,107,215	Sept. '16	0.12
Osceola, c.	Mich.	96,150	25	14,006,525	July '16	4.00
Pacific Mines Corpn., g.	Calif.	642,000	1	256,800	Aug. '16	0.02
Parrot, c.	Mont.	229,850	10	7,871,839	July '15	1.63
Pearl Con., g.	Wash.	1,909,711	0.05	181,422	Dec. '10	0.02
Pharmacist, g.	Colo.	1,500,000	1	87,500	Feb. '10	0.00½
Phelps, Dodge & Co.	U. S.	450,000	100	54,659,304	Sept. '16	8.00
Pioneer, g.	Alas.	5,000,000	1	2,041,526	Oct. '11	0.03
Pittsburgh-Idaho, l.	Ida.	809,407	1	217,083	Apr. '13	0.04
Pittsburg Silver Peak, g.	Nev.	2,790,000	1	771,200	July '14	0.02
Portland, g.	Colo.	3,000,000	1	10,447,080	July '16	0.03
Prince Con.	Nev.	1,000,000	2	300,000	Sept. '16	0.05
Quilp.	Wash.	1,500,000	1	67,500	Feb. '12	0.01
Quincy, c.	Mich.	110,000	25	22,987,500	Sept. '16	4.00
Ray, c.	Ariz	1,577,179	10	7,353,921	Sept. '16	0.75
Reorg. Booth, g.	Nev.	1,000,000	1	500,000	July '16	0.10
Republic, g.	Wash.	1,000,000	1	170,000	Nov. '12	0.01½
Rochester, l.z.	Mo.	4,900	100	190,846	July '12	0.50
Round Mountain, g.	Nev.	1,266,591	1	363,365	Aug. '13	0.04
Seven Troughs Coal., g.	Nev.	1,443,077	1	246,419	Apr. '16	0.02½
St. Joseph, l.	Mo.	1,409,466	10	12,029,681	Sept. '16	0.75
Shannon, c.	Ariz.	300,000	10	750,000	Jan. '13	0.50
Shattuck Arizona, c.	Ariz.	350,000	10	4,200,000	July '16	1.25
Silver King Coalition, l.s	Utah.	1,250,000	5	14,148,385	July '16	0.15
Silver King Con., l.s.	Utah.	637,582	1	942,573	July '16	0.10
Sioux Con., s.l.g.	Utah.	745,389	1	872,097	July '11	0.04
Skidoo, g.	Cal.	1,000,000	5	365,000	Oct. '14	0.01
Snowstorm, c.g.	Ida.	1,500,000	1	1,192,103	Oct. '13	0.02
Socorro, g.	N. M.	377,342	5	233,802	Sept. '16	0.05
South Eureka, g.	Calif.	299,981	1	722,870	May '16	0.07
Standard Con., g.s.	Cal.	178,394	10	5,274,407	Nov. '13	0.25
Stewart, s.l.	Ida.	1,238,362	1	2,012,314	Dec. '15	0.05
Stratton's Ind., g.	Colo.	1,000,000	0.60	618,625	Jan. '16	0.04
Success, z.	Ida.	1,500,000	1	1,125,000	July '16	0.03
Superior & Pitts., c.	Ariz.	1,499,792	10	10,318,569	Dec. '15	0.38
Tennessee, c.	Tenn.	200,000	25	5,206,250	Apr. '16	0.75
Tomboy, g.s.	Colo.	310,000	4.85	3,862,485	June '16	0.24
Tom Reed, g.	Ariz.	909,555	1	2,528,648	Oct. '15	0.01
Tonopah Belm't, s.g.	Nev.	1,500,000	1	8,205,531	July '15	0.12½
Tonopah Ext., g.s.	Nev.	1,272,801	1	1,400,827	July '16	0.15
Tonopah of Nev., s.g.	Nev.	1,000,000	1	13,450,000	July '16	0.15
Trimountain, c.	Mich.	100,000	25	1,450,000	Dec. '13	2.00
Tuolumne, c.	Mont.	2,500,000	1	520,000	May '13	0.10
Uncle Sam, g.s.l.	Utah.	500,000	1	495,000	Sept. '11	0.05
United Cop. Min., c.	Wash.	1,000,000	1	40,000	Nov. '12	0.01
United Globe, c.	Ariz.	23,000	100	3,749,000	Sept. '16	18.00
U. S. Steel Corp., com.	U. S.	5,083,025	100	246,504,807	Sept. '16	2.25
U. S. Steel Corp., pf.	U. S.	3,602,811	100	414,427,771	Aug. '16	1.75
U. S. S., R. & M., com.	U.S.-Mex.	351,115	50	7,327,909	July '16	1.00
U. S. S., R. & M., pf.	U.S.-Mex.	486,350	50	18,072,360	July '16	0.87½
United Verde, c.	Ariz.	300,000	100	39,322,000	Sept. '16	1.50
Utah, s.l.	Utah.	100,000	10	281,860	Dec. '10	0.02
Utah, c.	Utah.	1,624,490	10	46,530,062	Sept. '16	3.00
Utah Con., c.	Utah.	300,000	5	9,825,000	Sept. '16	0.75
Valley View, g.	Colo.	1,000,000	1	240,000	Dec. '10	0.04
Victoria, g.s.l.	Utah.	250,000	1	207,500	Mar. '10	0.04
Vindicator Con., g.	Colo.	1,500,000	1	3,442,500	July '16	0.06
Wasp No. 2, g.	S. D.	500,000	1	649,466	May '16	0.02½
Wellington Mines, g.	Colo.	10,000,000	1	1,050,000	July '16	0.02
Wolverine, c.	Mich.	60,000	25	8,760,000	Apr. '16	6.00
Yak, s.l.	Colo.	1,000,000	1	2,127,685	June '16	0.07
Yankee Con., g.s.	Utah.	1,000,000	1	167,500	Jan. '13	0.01
Yellow Aster, g.	Cal.	100,000	10	1,185,789	June '16	0.12
Yellow Pine, l.z.s.	Nev.	1,000,000	1	1,593,008	Sept. '16	0.10
Yukon Gold, g.	Alas.	3,500,000	5	8,370,610	Sept. '16	0.07½

Canadian, Mexican and Central American Companies

Ajuchitlan, g.s.	Mex.	50,000	$ 5	$ 212,500	Oct. '12	$0.25
Amparo, g.s.	Mex.	2,000,000	1	1,960,883	Aug. '16	0.05
B. C. Copper	B. C.	591,709	5	615,399	Jan. '13	0.15
Beaver Con., s.	Ont.	2,000,000	1	649,912	Apr. '16	0.03
Buffalo, s.	Ont.	1,000,000	1	2,787,000	July '14	0.05
Canadian Goldfields, g.	B. C.	600,000	0.10	290,000	July '14	0.001½
Chontalpan, g.s.l.z.	Mex.	7,000	25	61,250	May '14	0.75
Cobalt Townsite, s.	Ont.	45,000	1	1,042,259	May '14	0.10
Coniagas, s.	Ont.	800,000	5	8,240,000	Aug. '16	0.25
Con. M. & S. Co. of Can	B. C.	337,100	25	2,739,796	July '16	2.50
Crown Reserve, s.	Ont.	1,999,957	1	6,102,408	July '15	0.02
Dome Mines, s.	Ont.	400,000	10	1,000,000	Sept. '16	0.50
Dos Estrellas, g.s.	Mex.	300,000	0.50	10,335,000	Dec. '13	1.50
El Oro, g.s.	Mex.	1,147,500	4.85	8,947,260	July '13	0.24
Esperanza, s.g.	Mex.	455,000	4.85	12,013,882	July '15	0.24
Granby, s.l.c.	B.C.	149,985	100	6,575,289	Aug. '16	2.00
Greene Cananea.	Mex.	488,414	100	6,816,028	Aug. '16	2.00
Greene Con., c.	Mex.	1,000,000	10	12,044,400	May '16	1.00
Guanajuato D., pf., s.	Mex.	10,000	1000	214,356	Jan. '10	3.00
Hedley Gold.	B. C.	120,000	10	2,003,520	Sept. '16	0.50
Hollinger, g.	Ont.	600,000	5	5,250,000	Sept. '16	0.05
Kerr Lake, s.	Ont.	600,000	5	6,570,000	Sept. '16	0.25
La Rose Con., s.	Ont.	1,498,627	5	5,611,914	July '16	0.05
Le Roi No. 2, g.	B. C.	120,000	24.30	1,566,450	Mar. '16	0.30
Lucky Tiger Com., g.	Mex.	715,337	10	3,470,839	June '16	0.08
McK.-Dar. Sav. s.	Ont.	2,247,692	1	4,742,625	July '16	0.03
Mines Co. of Am. (new)	Mex.	862,658	10	4,958,600	July '13	0.12½
N. Y. & Hond. Ros., g.	C. A.	200,000	10	4,090,000	July '16	0.50
Nipissing, s.	Ont.	1,200,000	5	14,340,000	July '16	0.25
Peñoles, s.l.g.	Mex.	80,000	25	6,361,688	June '13	1.25
Pinguico, pf., s.	Mex.	20,000	100	840,000	Oct. '13	3.00
Right of Way Mns, s.	Ont.	1,685,500	1	569,042	Sept. '16	0.00½
Rio Plata, s.	Mex.	374,518	5	345,745	Feb. '13	0.05
San Rafael, g.s.	Mex.	2,400	25	1,442,380	Jan. '14	0.50
San Toy, g.s.	Mex.	5,750,000	1	530,000	July '13	0.01
Seneca-Superior	Ont.	478,884	1	1,460,096	Aug. '16	0.30
Sorpresa, g.s.	Mex.	19,200	20	3,979,240	Jan. '11	34.00
Stand'd Silver-Lead.	B. C.	2,000,000	1	2,250,000	Sept. '16	0.02½
Temiskaming, s.	Ont.	2,500,000	1	1,609,156	July '16	0.03
Tem. & Hud. Bay, s.	Ont.	7,761	1	1,940,250	Nov. '14	3.00
Trethewey, s.	Ont.	1,000,000	1	1,061,998	July '14	0.05
Wettlaufer-Lorrain, s.	Ont.	1,416,590	1	637,465	Oct. '13	0.05